Egyptian Drilling Company
EDC Training Center

Lifting and Slinging

Index

Subjects — Page

Course Objectives

- **Demonstrate knowledge of the legislation, regulations and standards governing the use of lifting equipment.**
- **Demonstrate knowledge of Force Influences & Rating Methods.**
- **Demonstrate how to do Load Estimation.**
- **Demonstrate knowledge of different types of slings and how to carry out a pre use check.**
- **Demonstrate knowledge of different types of lifting accessories and how to carry out a pre use check.**
- **Demonstrate knowledge of how to complete a lift plan.**
- **Demonstrate knowledge of crane signals in accordance with BS 7121.**
- **Practical Assessment.**

Legislations, regulations and standards governing the use of lifting equipment

British & European Legislation

British law (Criminal Law & Civil Law)

Criminal Law

Intention of the Criminal Law

The intention of the criminal law is to ensure that every citizen knows the boundaries of acceptable conduct in the UK, for example it is clearly unacceptable conduct to steal from another individual – thereby it is necessary to have the criminal law of theft under the Theft Act 1968. This clearly applies to other criminal offences such as murder and rape.

Wrong against Society

A breach of the criminal laws imposed by society will be seen as a wrong against society as a whole. Therefore if the boundaries of acceptable conduct in the UK have been exceeded by an individual and that individual has been caught they will face prosecution by the state and will receive an adequate punishment such as a fine or in some cases imprisonment or a community sentence.

Civil Law

Intention of the Civil Law

The main intention of the civil law is to protect individuals against one another specifying the rights and duties of individuals. For example if we look at individuals using the highway, road users have a duty of care to other individuals using the road. If for example one individual road user is driving in a poor manner and causes an accident which injures another, a civil claim can be brought under the laws of negligence.

In order for negligence to be established the following elements must be present:

1. A duty of care
2. This duty of care must have been breached
3. The breach must have caused injury to another

Furthermore if we look at the employment sector we can see that all employees have a right to be safe and work in a safe environment at work. This means that their employers have a duty to protect their safety. If an employer does not do this and an employee becomes injured this will bring about a civil claim.

European Union law

Is a body of treaties and legislation, such as Regulations and Directives, which have direct effect or indirect effect on the laws of European Union member states. The three sources of European Union law are primary law, secondary law and supplementary law. The main sources of primary law are the Treaties establishing the European Union. Secondary sources include regulations and directives which are based on the Treaties. The legislature of the European Union is principally composed of the European Parliament and the Council of the European Union, which under the Treaties may establish secondary law to pursue the objective set out in the Treaties.

European Union law is applied by the courts of member states and the Court of Justice of the European Union. Where the laws of member states provide for lesser rights European Union law can be enforced by the courts of member states. In case of European Union law which should have been transposed into the laws of member states, such as Directives, the European Commission can take proceedings against the member state under the Treaty on the Functioning of the European Union. The Court of Justice of the European Union is the highest court able to interpret European Union law. Supplementary sources of European Union law

include case law by the Court of Justice, international law and general principles of European Union law.

Health & Safety at Work Summary

Section 2

General duties of employers and self-employed to persons other than their-employees.

(1) It shall be the duty of every employer and every self-employed person to conduct his undertaking in such a manner as to ensure, so far as is practicable, that he and other persons, not being his employees, who may be affected thereby are not thereby exposed to risks to their safety or health.

(2) It shall be the duty of every employer and every self-employed person, in the prescribed circumstances and in the prescribed manner, to give to persons, not being his employees, who may be affected by the manner in which he conducts his undertaking, the prescribed information on such aspects of the manner in which he conducts his undertaking as might affect their safety or health.

What employers must do for you?

1. Decide what could harm you in your job and the precautions to stop it. This is part of risk assessment.
2. In a way you can understand, explain how risks will be controlled and tell you who is responsible for this.
3. Consult and work with you and your health and safety representatives in protecting everyone from harm in the workplace.
4. Free of charge; give you the health and safety training you need to do your job.
5. Free of charge, provide you with any equipment and protective clothing you need, and ensure it is properly looked after.
6. Provide toilets, washing facilities and drinking water.
7. Provide adequate first-aid facilities.
8. Report major injuries and fatalities at work.

9. Have insurance that covers you in case you get hurt at work or ill through work. Display a hard copy or electronic copy of the current insurance certificate where you can easily read it.
10. Work with any other employers or contractors sharing the workplace or providing employees (such as agency workers), so that everyone's health and safety is protected.

Section 6

General duties of manufacturers etc. as regards articles and substances for use at work.

(1) It shall be the duty of a person who formulates, manufactures, imports or supplies any substance for use at work—

a) to ensure, so far as is practicable, that the substance is safe and without risks to health when properly used;
b) to carry out or arrange for the carrying out of such testing and examination as may be necessary for the performance of the duty imposed on him by paragraph (a); and
c) to take such steps as are necessary to ensure that there will be available in connection with the use of the substance at work adequate information about the results of any relevant test which has been carried out on or in connection with the substance and about any condition necessary to ensure that it will be safe and without risks to health when properly used.

(2) It shall be the duty of a person who undertakes the manufacture or supply of any substance for use at work to carry out or arrange for the carrying out of any necessary research with a view to the discovery and, so far as is practicable, the elimination or minimization of any risk to safety or health to which the substance may give rise.

CE Marking is the symbol as shown on the top of this page. The letters **"CE"** are the abbreviation of French phrase **"Conformité Européene"** which literally means "European Conformity". The term initially used was "EC Mark" and it was officially replaced by "CE Marking" in the Directive 93/68/EEC in 1993. "CE Marking" is now used in all EU official documents.

- CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislation, in practice by many of the so-called Product Directives.

- CE Marking on a product indicates to governmental officials that the product may be legally placed on the market in their country.

- CE Marking on a product ensures the free movement of the product within the EFTA & European Union (EU) single market (total 28 countries), and

- CE Marking on a product permits the withdrawal of the non-conforming products by customs and enforcement/vigilance authorities.

Section 7 & 8

(1) It shall be the duty of every employee while at work—

a) to take reasonable care for the safety and health of himself and of other persons who may be affected by his acts or omissions at work;

b) to co-operate with his employer or any other person in the discharge of any duty or requirement imposed on the employer or that other person by this Act or any regulation made thereunder;

c) to wear or use at all times any protective equipment or clothing provided by the employer for the purpose of preventing risks to his safety and health; and

d) To comply with any instruction or measure on occupational safety and health instituted by his employer or any other person by or under this Act or any regulation made thereunder.

(2) A person who contravenes the provisions of this section shall be guilty of an offence and shall, on conviction, be liable to a fine not exceeding one thousand ringgit or to imprisonment for a term not exceeding three months or to both.

- **Duty not to interfere with or misuse things provided pursuant to certain provisions.**

A person who intentionally, recklessly or negligently interferes with or misuses anything provided or done in the interests of safety, health and welfare in pursuance of this Act shall be guilty of an offence and shall, on conviction, be liable to a fine not exceeding twenty thousand ringgit or to imprisonment for a term not exceeding two years or to both.

Lifting Equipment Definitions & Terminology

Lifting Operation

Regulation 8(2) of LOLER defines a lifting operation as '… an operation concerned with the lifting or lowering of a load'. A 'load' is the item or items being lifted, which includes a person or people.

Lifting Equipment

Lifting equipment is any work equipment for lifting and lowering loads.

Lifting Accessories

Pieces of equipment that are used to attach the load to lifting equipment, providing a link between the two. Any lifting accessories used between lifting equipment and the load may need to be taken into account in determining the overall weight of the load.

Lifting Machine

an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application

Thorough Examination

Lifting equipment must be thoroughly examined in a number of situations, including:

- Before first use (unless there is a valid Declaration of Conformity made less than 6/12 months earlier).
- Where it depends on installation, or re-installation / assembly at another site.

- Where it is exposed to conditions causing deterioration, liable to result in danger.

- Records of thorough examinations should be made and, where defects are identified, they should be reported to both the person using the equipment (and to any person from whom it has been hired or leased), and the relevant enforcing authority (HSE for industrial workplaces; local authorities for most other workplaces).

In Service Inspection / Pre Use Check

Outwith testing/examination which is carried out by a competent person, it is your responsibility (an employee) to visually examine any item of lifting equipment immediately prior to use.

Working Load Limit (WLL)

Is the maximum working load designed by the manufacturer this load represents a force that is much less than that required making the lifting equipment fail or yield.

Safe Working Load (SWL)

The maximum load (determine by a competent person) which an item of lifting equipment may raise, lower or suspend under particular service conditions

Note: normally, the SWL equals the WLL (unless the lifting equipment has been de-rated).

Factor of Safety

The factor of safety is the ratio between the minimum breaking load and the working load limit.

Mode Factor

SWL and WLL of lifting equipment will depends on slinging mode factor, i.e. the angle between slings, how many slings being used, number of lifting appliances involved in the lifting operation.

Provision and Use of Work Equipment Regulations 1998 (PUWER '98)

- These regulations are aimed at safeguarding the health and safety of employees from hazards arising from the provision and use of work equipment. They contain general requirements covering all hazards and specific minimum requirements on selected hazards.
- There is also some overlap between PUWER and other sets of regulations, for example:
  - The Lifting Operations and Lifting Equipment Regulations 19981 (LOLER) applies over and above the general requirements of PUWER in dealing with specific hazards/risks associated with lifting equipment and lifting operations;
  - The Workplace (Health, Safety and Welfare) Regulations 1992 (workplace risks to pedestrians from vehicles);
  - The Health and Safety (Display Screen Equipment) Regulations 1992 (for example, on lighting);
  - The Personal Protective Equipment at Work Regulations 1992 (PPE) (for example, on maintenance);
  - The Construction (Design and Management) Regulations 2007 (CDM);
  - The Road Vehicles (Construction and Use) Regulations 1986;
  - The Work at Height Regulations 2005 (relating to inspection of work equipment for use when working at height);
  - The Management of Health and Safety at Work Regulations 1999 (the Management Regulations) (relating to risk assessments).

Regulation 3 – Application

1) These Regulations shall apply –

(a) In Great Britain; and

(b) Outside Great Britain as sections 1 to 59 and 80 to 82 of the 1974 Act apply by virtue of the Health and Safety at Work etc. Act 1974 (Application outside Great Britain) Order 1995(a) ("the 1995 Order").

2) The requirements imposed by these Regulations on an employer in respect of work equipment shall apply to such equipment provided for use or used by an employee of his at work.

3) The requirements imposed by these Regulations on an employer shall also apply –

(a) To a self-employed person, in respect of work equipment he uses at work;

(b) subject to paragraph (5), to a person who has control to any extent of

(i) work equipment;

(ii) A person at work who uses or supervises or manages the use of work equipment; or

(iii) The way in which work equipment is used at work, and to the extent of his control.

4) Any reference in paragraph (3)(b) to a person having control is a reference to a person having control in connection with the carrying on by him of a trade, business or other undertaking (whether for profit or not).

5) The requirements imposed by these Regulations shall not apply to a person in respect of work equipment supplied by him by way of sale, agreement for sale or hire-purchase agreement.

6) Subject to paragraphs (7) to (10), these Regulations shall not impose any obligation in relation to a ship's work equipment (whether that equipment is used on or off the ship).

7) Where merchant shipping requirements are applicable to a ship's work equipment, paragraph shall relieve the shore employer of his obligations under these Regulations in respect of that equipment only where he has taken all reasonable steps to satisfy himself that the merchant shipping requirements are being complied with in respect of that equipment.

8) In a case where the merchant shipping requirements are not applicable to the ship's work equipment by reason only that for the time being there is no master, crew or watchman on the ship, those requirements shall nevertheless be treated for the purpose of paragraph as if they were applicable.

9) Where the ship's work equipment is used in a specified operation paragraph (6) shall not apply to regulations 7 to 9, 11 to 13, 20 to 22 and 30 (each as applied by regulation 3).

10) Paragraph (6) does not apply to a ship's work equipment provided for use or used in an activity (whether carried on in or outside Great Britain) specified in the 1995 Order* save that it does apply to –

(a) The loading, unloading, fuelling or provisioning of the ship; or
(b) The construction, reconstruction, finishing, refitting, repair, maintenance, cleaning or breaking up of the ship.

Regulation 4 – Suitability

(1) Every employer shall ensure that work equipment is so constructed or adapted as to be suitable for the purpose for which it is used or provided.

(2) In selecting work equipment, every employer shall have regard to the working conditions and to the risks to the health and safety of persons which exist in the premises or undertaking in which that work equipment is to be used and any additional risk posed by the use of that work equipment.

Regulation 5 – Maintenance

(1) Every employer shall ensure that work equipment is maintained in an efficient state, in efficient working order and in good repair.

(2) Every employer shall ensure that where any machinery has a maintenance log, the log is kept up to date.

Regulation 6 – Inspection

(1) Every employer shall ensure that, where the safety of work equipment depends on the installation conditions, it is inspected –

(a) After installation and before being put into service for the first time; o
(b) After assembly at a new site or in a new location, to ensure that it has been installed correctly and is safe to operate.

(2) Every employer shall ensure that work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is inspected –

(a) At suitable intervals; and

(b) Each time that exceptional circumstances which are liable to jeopardise the safety of the work equipment have occurred, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.

Regulation 8 – Information & Instruction

(1) Every employer shall ensure that all persons who use work equipment have available to them adequate health and safety information and, where appropriate, written instructions pertaining to the use of the work equipment.

(2) Every employer shall ensure that any of his employees who supervises or manages the use of work equipment has available to him adequate health and safety information and, where appropriate, written instructions pertaining to the use of the work equipment.

(3) Without prejudice to the generality of paragraphs (1) or (2), the information and instructions required by either of those paragraphs shall include information and, where appropriate, written instructions on –

(a) The conditions in which and the methods by which the work equipment may be used;

(b) Foreseeable abnormal situations and the action to be taken if such a situation were to occur; and

(c) Any conclusions to be drawn from experience in using the work equipment.

(4) Information and instructions required by this regulation shall be readily comprehensible to those concerned.

Regulation 9 – Training

(1) Every employer shall ensure that all persons who use work equipment have received adequate training for purposes of health and safety, including training in the methods which may be

adopted when using the work equipment, any risks which such use may entail and precautions to be taken.

(2) Every employer shall ensure that any of his employees who supervises or manages the use of work equipment has received adequate training for purposes of health and safety.

Lifting Operation & Lifting Equipment Regulations LOLER '98

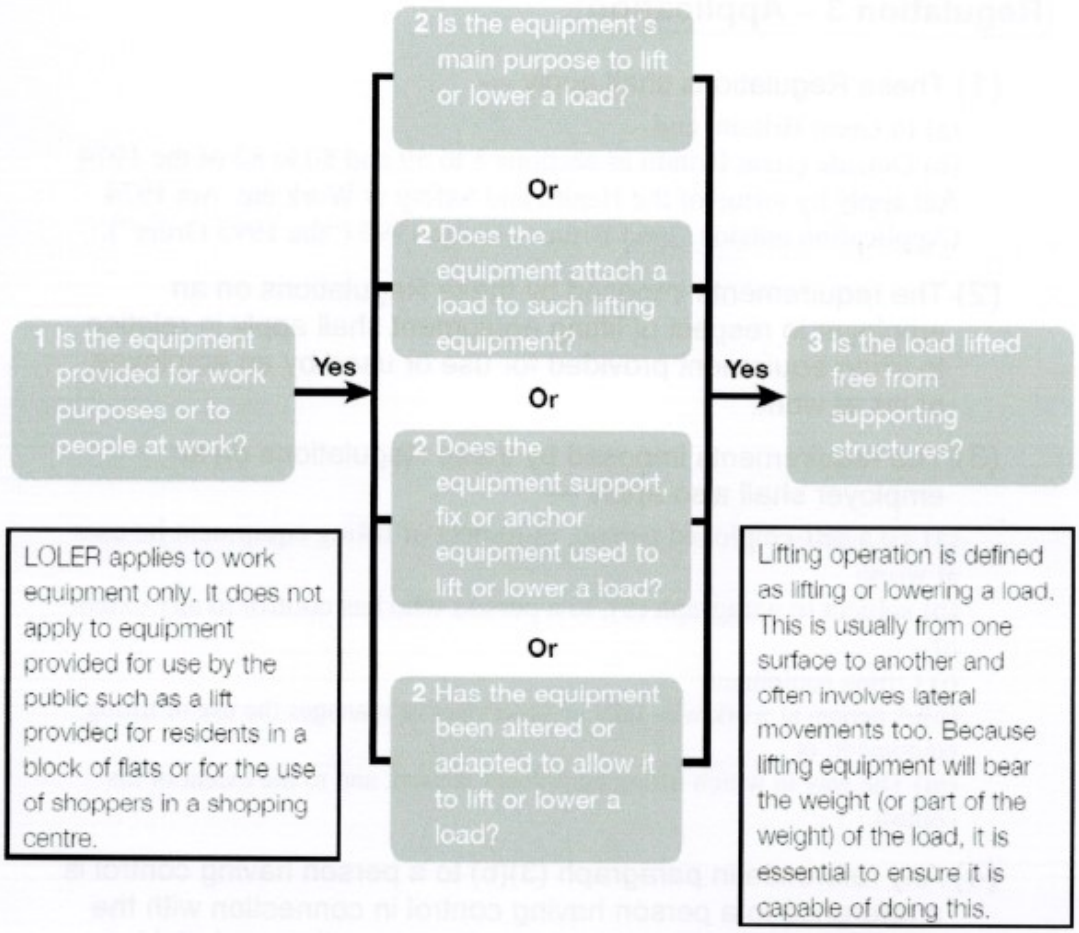
- These Regulations (often abbreviated to LOLER) place duties on people and companies who own, operate or have control over lifting equipment. This includes all businesses and organisations whose employees use lifting equipment, whether owned by them or not. In most cases, lifting equipment is also work equipment so the Provision and Use of Work Equipment Regulations (PUWER) will also apply (including inspection and maintenance). All lifting operations involving lifting equipment must be properly planned by a competent person, appropriately supervised and carried out in a safe manner.
- LOLER also requires that all equipment used for lifting is fit for purpose, appropriate for the task, suitably marked and, in many cases, subject to statutory periodic 'thorough examination'. Records must be kept of all thorough examinations and any defects found must be reported to both the person responsible for the equipment and the relevant enforcing authority.
- LOLER is supported by the Safe use of lifting equipment: Approved Code of Practice (ACOP) and additional free guidance from HSE.
- While the ACOP is not law, this has been produced under section 16 of the Health and Safety at Work Act (HSW Act) and has a special status, This supports not only LOLER but also the general provisions of section 2 of the HSW Act and other regulations, including the Management of Health and Safety at Work Regulations and PUWER, in relation to lifting equipment and lifting operations.

Regulation 2 – Interpretation

Regulation 2 clarifies the meaning of terms used in LOLER.

- **"The 1974 Act":** means the Health and Safety at Work etc. Act 1974;
- **"accessory for lifting":** means work equipment for attaching loads to machinery for lifting;

- **"EC declaration of conformity":** means a declaration which complies with:
  (a) Section A of part 1 of Part 2 of Schedule 2 to the Supply of Machinery (Safety) Regulations 2008;
  (b) Article 12.1 of Council Directive 89/686/EEC on the approximation of the laws of the Member States relating to personal protective equipment;
  (c) Regulation 8(2) (d) of the Lifts Regulations 1997.
- **"Employer":** except in regulation 3(2) and (3) includes a person to whom the requirements imposed by these Regulations apply by virtue of regulation 3(3)(a) and (b);
- **"essential requirements":** has the same meaning as in the Provision and Use of Work Equipment Regulations 1998;
- **"examination scheme":** means a suitable scheme drawn up by a competent person for such thorough examinations of lifting equipment at such intervals as may be appropriate for the purpose described in regulation 9(3);
- **"the Executive":** means the Health and Safety Executive;
- **"lifting equipment":** means work equipment for lifting or lowering loads and includes its attachments used for anchoring, fixing or supporting it;
- **"lifting operation":** has the meaning given in regulation 8(2);
- **"load":** includes a person;
- **"thorough examination":** in relation to a thorough examination under paragraph (1), (2) or (3) of regulation 9 —
  (a) means a thorough examination by a competent person;
  (b) Where it is appropriate to carry out testing for the purpose described in the paragraph, includes such testing by a competent person as is appropriate for the purpose,



If you answer yes to question 1 **and** any of the options in column 2 **and** question 3, the equipment is likely to be subject to LOLER.

If you have answered no to question 1 you may still have duties under section 3 or 4 of the HSW Act to ensure the safety of users.

If you have answered no to all the options in column 2 **and/or** question 3, your equipment may still be subject to the need for inspection and maintenance under the provisions of PUWER.

Regulation 3 – Application

(1) These Regulations shall apply —

(a) In Great Britain; and

(b) Outside Great Britain as sections 1 to 59 and 80 to 82 of the 1974 Act apply by virtue of the Health and Safety at Work etc. Act 1974 (Application outside Great Britain) Order 1995 ("the 1995 Order").

(2) The requirements imposed by these Regulations on an employer in respect of lifting equipment shall apply in relation to lifting equipment provided for use or used by an employee of his at work.

(3) The requirements imposed by these Regulations on an employer shall also apply —

(a) To a self-employed person, in respect of lifting equipment he uses at work;

(b) subject to paragraph (5), to a person who has control to any extent of —

(i) Lifting equipment;

(ii) A person at work who uses or supervises or manages the use of lifting equipment; or

(iii) The way in which lifting equipment is used, and to the extent of his control.

(4) Any reference in paragraph (3)(b) to a person having control is a reference to a person having control in connection with the carrying on by him of a trade, business or other undertaking (whether for profit or not).

(5) The requirements imposed by these Regulations on an employer shall not apply to a person in respect of lifting equipment supplied by him by way of sale, agreement for sale or hire-purchase agreement.

(6) Subject to paragraphs (7) to (10), these Regulations shall not impose any obligation in relation to a ship's work equipment (whether that equipment is used on or off the ship).

(7) Where merchant shipping requirements are applicable to a ship's work equipment, paragraph (6) shall relieve the shore employer of his obligations under these Regulations in respect of that equipment only where he has taken all reasonable steps to satisfy himself that the merchant shipping requirements are being complied with in respect of that equipment.

(8) In a case where the merchant shipping requirements are not applicable to the ship's work equipment by reason only that for the time being there is no master, crew or watchman on the ship, those requirements shall nevertheless be treated for the purpose of paragraph (7) as if they were applicable.

(9) Where the ship's work equipment is used in a specified operation paragraph (6) shall not apply to regulations 6 and 8 (each as applied by regulation 3).

(10) Paragraph (6) does not apply to a ship's work equipment provided for use or used in an activity (whether carried on in or outside Great Britain) specified in the 1995 Order* save that it does apply to:-

(a) The loading, unloading, fuelling or provisioning of the ship; or
(b) The construction, reconstruction, finishing, refitting, repair, maintenance, cleaning or breaking up of the ship.

Regulation 7 – Marking of lifting equipment

- Regulation 7 details the requirements for clearly labelling or, otherwise making available, details of the safe working load of each piece of lifting equipment or accessory.
- Every employer shall ensure that —

(a) Subject to sub-paragraph (b), machinery and accessories for lifting loads are clearly marked to indicate their safe working loads;

(b) Where the safe working load of machinery for lifting loads depends on its configuration —
(i) The machinery is clearly marked to indicate its safe working load for each configuration; or
(ii) Information which clearly indicates its safe working load for each configuration is kept with the machinery;
(c) Accessories for lifting are also marked in such a way that it is possible to identify the characteristics necessary for their safe use;
(d) Lifting equipment which is designed for lifting persons is appropriately and clearly marked to this effect; and
(e) Lifting equipment which is not designed for lifting persons but which might be so used in error is appropriately and clearly marked to the effect that it is not designed for lifting persons.

Regulation 8 – Organisation of lifting operations

- Regulation 8(1) clarifies that each lifting operation needs to be planned, supervised and carried out safely.
- Regulation 8(2) defines a lifting operation.

(1) Every employer shall ensure that every lifting operation involving lifting equipment is —
(a) Properly planned by a competent person;
(b) Appropriately supervised; and
(c) Carried out in a safe manner.
(2) In this regulation "lifting operation" means an operation concerned with the lifting or lowering of a load.

Regulation 9 - Thorough examination and inspection

- Regulation 9 puts in place requirements for all lifting equipment to be subject to 'thorough examination' at various points.
- Regulation 9(3) requires periodic thorough examination where equipment is subject to deterioration due to use and where this deterioration could lead to a dangerous situation. The frequency depends on the type of equipment and the purposes for which it is used, e.g. equipment used for lifting people requires more frequent examination. The periods

stated are the maximum periods between each examination unless there is an examination scheme produced by a competent person in place, which can specify longer or shorter periods depending on the risk of defects arising.

- Regulation 9(4) requires that no lifting equipment leaves a business and/or is used, including when received from a third party, unless there is physical evidence that the required thorough examination has been completed.

(1) Every employer shall ensure that before lifting equipment is put into service for the first time by him it is thoroughly examined for any defect unless either —

(a) The lifting equipment has not been used before; and
(b) In the case of lifting equipment for which an EC declaration of conformity could or (in the case of a declaration under the Lifts Regulations 1997) should have been drawn up, the employer has received such declaration made not more than 12 months before the lifting equipment is put into service;

(2) Every employer shall ensure that, where the safety of lifting equipment depends on the installation conditions, it is thoroughly examined —

(a) After installation and before being put into service for the first time; and
(b) After assembly and before being put into service at a new site or in a new location, to ensure that it has been installed correctly and is safe to operate.

(3) Subject to paragraph (6), every employer shall ensure that lifting equipment which is exposed to conditions causing deterioration which is liable to result in dangerous situations is —

(a) Thoroughly examined —
(i) In the case of lifting equipment for lifting persons or an accessory for lifting, at least every 6 months;
(ii) In the case of other lifting equipment, at least every 12 months; or
(iii) In either case, in accordance with an examination scheme; and
(iv) Each time that exceptional circumstances which are liable to jeopardise the safety of the lifting equipment have occurred; and,

(b) If appropriate for the purpose, is inspected by a competent person at suitable intervals between thorough examinations, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.

(4) Every employer shall ensure that no lifting equipment —
(a) Leaves his undertaking; or
(b) If obtained from the undertaking of another person, is used in his undertaking, unless it is accompanied by physical evidence that the last thorough examination required to be carried out under this regulation has been carried out.

(5) This regulation does not apply to winding apparatus to which the Mines (Shafts and Winding) Regulations 1993 apply.

(6) Where lifting equipment was before the coming into force of these Regulations required to be thoroughly examined by a provision specified in paragraph (7), the first thorough examination under paragraph (3) shall be made before the date by which a thorough examination would have been required by that provision had it remained in force.

(7) The provisions referred to in paragraph (6) are —
(a) Section 22(2), 25(2), 26(1)(d) and 27(2) of the Factories Act 1961;
(b) [Revoked by SI 2013/448.]
(c) Regulations 28(3), 40 and 46(1) of the Construction (Lifting Operations) Regulations 1961;
(d) Regulations 3(1) and (2) and 6(1) of the Offices, Shops and Railway Premises (Hoists and Lifts) Regulations 1968;
(e) regulation 6(1)(c) of and Part III of Schedule 1 to the Offshore Installations (Operational Safety, Health and Welfare) Regulations 1976;
(f) [Revoked by SI 2013/1512.]

Regulation 10 - Reports & Defects

- Regulation 10 places responsibilities on the competent person carrying out thorough examinations to produce a report containing, as a minimum, the information specified in Schedule 1 to these Regulations.

- Regulation 10(1) (c) requires, where a defect presents immediate or imminent risk of serious personal injury, a copy of the report be sent to the relevant enforcement authority defined in 10(4).

- Regulation 10(3) stipulates that the employer should not use a piece of equipment where a defect has been identified for immediate rectification, until that defect has been rectified. Where other defects are identified a date for their rectification should be identified in the report and the equipment should not be used after that date unless the defects have been rectified.

(1) A person making a thorough examination for an employer under regulation 9 shall —

(a) Notify the employer forthwith of any defect in the lifting equipment which in his opinion is or could become a danger to persons;

(b) as soon as is practicable make a report of the thorough examination in writing authenticated by him or on his behalf by signature or equally secure means and containing the information specified in Schedule 1 to —

(i) The employer; and

(ii) Any person from whom the lifting equipment has been hired or leased;

(c) Where there is in his opinion a defect in the lifting equipment involving an existing or imminent risk of serious personal injury send a copy of the report as soon as is practicable to the relevant enforcing authority.

(2) A person making an inspection for an employer under regulation 9 shall —

(a) Notify the employer forthwith of any defect in the lifting equipment which in his opinion is or could become a danger to persons;

(b) as soon as is practicable make a record of the inspection in writing.

(3) Every employer who has been notified under paragraph (1) shall ensure that the lifting equipment is not used —

(a) Before the defect is rectified; or

(b) In a case to which sub-paragraph (c) of paragraph 8 of Schedule 1 applies, after a time specified under that sub-paragraph and before the defect is rectified.

(4) In this regulation "relevant enforcing authority" means

Where the defective equipment has been hired or leased by the employer, the Executive.

Requirements for a Pre Use Check

- Pre-use inspections are required before use of any equipment or work process that has a potential to result in a severe loss. This inspection must be recorded in a log that is kept on the equipment or near the process and be available for review. Individual departments are responsible for identifying and completing the pre use checklist.

- Who conducts the inspection?

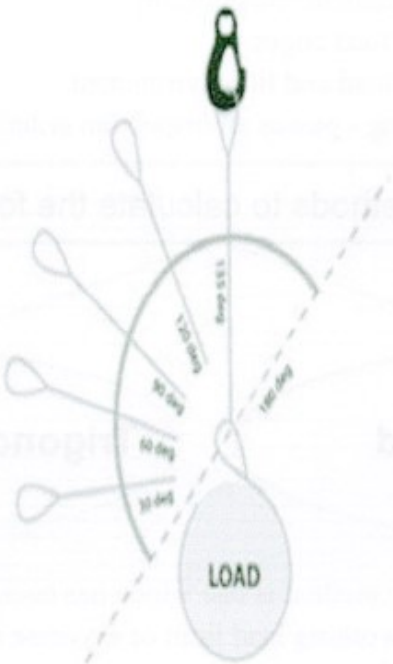
These inspections are conducted prior to use for the first time that day, the employee using the equipment must check the inspection log and determine if it has been inspected. Many pieces of equipment are used several times a day and they will only require the pre use inspections once on any given day. In cases where equipment is not used daily, a pre use inspection is not necessary until the day it is used.

The employee conducting the pre use inspection completes the inspection and then dates and signs the checklist and returns it to the appropriate location.

- Corrective action

If during the course of the pre use inspection the employee determines that there is a deficiency this must be corrected before use. If it is a minor issue that the employee can correct then the equipment can be used. If the deficiency is of a nature that the employee cannot correct to make the equipment safe to use then the equipment must be taken out of service and the supervisor must be immediately contacted.

Force Influences & Rating Methods



Calculate the forces in slings

- Calculate the forces in slings assist you in selecting the appropriate size slings for your lifting applications.
- Factors you must consider include:

- Type of hitch/method of rigging.
- Effect of angle on capacity.
- Chemical environment compatibility.
- Protection from load edges.
- Temperature of load and lift environment.
- Condition of sling - passes all inspection criteria.

There are 2 methods to calculate the forces in slings

Uniform Load Method

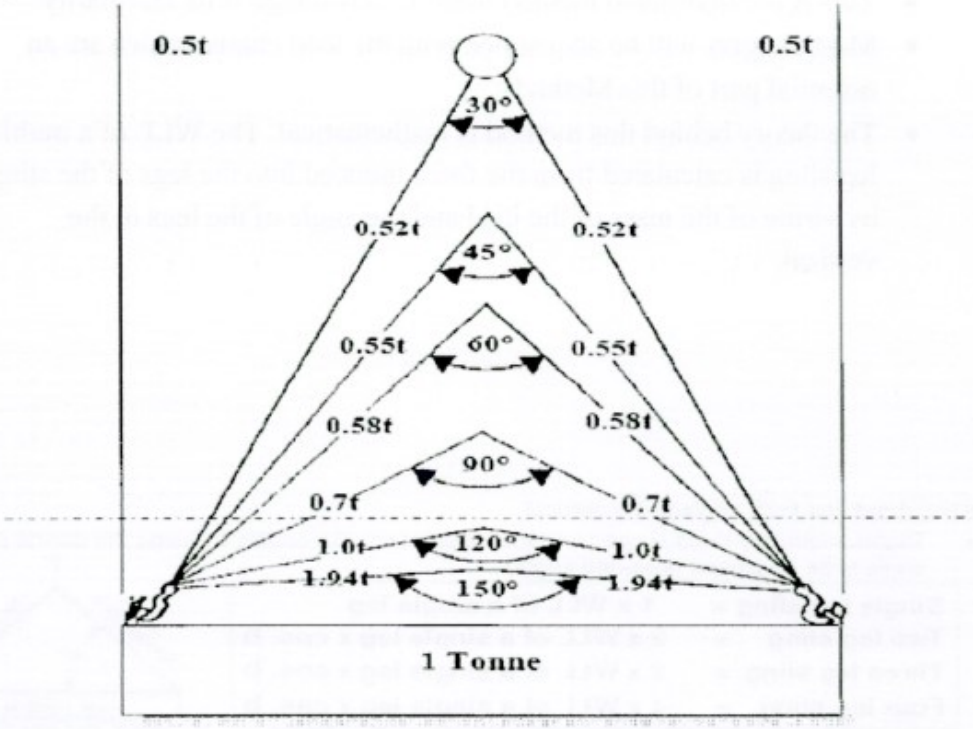
Trigonometric Load Method

- The trigonometric method is one which has been traditionally used and it allows the working load limit or decrease according to the angle between the sling legs.
- The uniform load method simplifies matters by removing the need for tables and reducing the need for the operator to estimate angles.

- Both of these methods do, however, assume that certain conditions of use are imposed to ensure that no part of the sling can become overloaded. It is important to understand that although the weight to be lifted may be within the maximum lifting capacity of the sling, lifting in the wrong way can place an excess of load onto one part of the sling.
- Whichever rating method is used, multi-leg slings MUST NOT be used at an included angle greater than 120°.

Uniform Load Method :

When a multi-leg sling is used with the sling legs at an angle, the load in the individual sling leg s will increase as the angle between the legs becomes greater.



- Angles greater than 120° are not accepted. The area below the dashed line shows excessive load in sling legs at extreme angles.

- The uniform load method proposes a fixed relationship between the WLLs of single-leg and multi-leg slings according to the following table:

Single-leg	Two-leg Included angle 0° - 90°	Two-leg Included angle 90°- 120°	Three- and four-leg Included angle 0°- 90°	Four-legged Included angle 90° - 120°
1.0	1.4	1.0	2.1	1.5

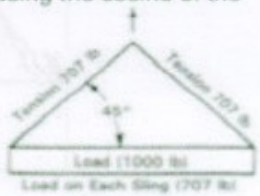
Trigonometric Load Method

- This is the traditional method used; its advantage is its familiarity.
- Most slingers will be acquainted with the load charts, which are an essential part of this Method.
- The theory behind this method is mathematical. The WLL of a multi-leg sling is calculated from the force induced into the legs of the sling by virtue of the mass of the load and the angle of the legs to the vertical.

Sling rated at a fixed angle to the vertical.

- Trigonometrically rated slings can be re-rated at smaller angles by using the cosine of the angle to be employed (included angle)

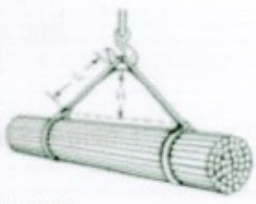
Single leg sling	=	1 x WLL of a single leg
Two leg sling	=	2 x WLL of a single leg x cos. b
Three leg sling	=	3 x WLL of a single leg x cos. b
Four leg sling	=	4 x WLL of a single leg x cos. b



Normally tables are available with the calculation already done

Divide sling height [H] by sling length [L].= REDUCTION FACTOR= H/L

Divided sling length [L] by sling height [H]= TENSION FACTOR = L/H



SWL EACH SLING = (LOAD/NUMBER OF LEG SLING)/ REDUCTION FACTOR
SWL EACH SLING = (LOAD/NUMBER OF LEG SLING)x TENSION FACTOR

REDUCED CAPACITY

How to do Load Estimation

Calculating Load Weight(s)

Importance: The most important slinging precaution is to determine the weight of all loads before attempting to lift them, to make ample allowances for unknown factors, and to determine the available capacity of the equipment being used, in cases where the assessment of load weight is difficult, safe load indicators or weighing devices should be fitted.

Step 1: Determine volume

- Measure the object to get dimensions (length, width, and height) and determine volume.

Volume formulas:

- **Rectangle/square:** Volume = Length x Width x Height
- **Hollow cylinder:** Volume = 3.14 x Length x Wall thickness x (Diameter wall thickness)
- **Complex shapes:**

- In some cases, it's best to imagine that the whole object is enclosed by a rectangle and calculate the volume of that rectangle.

- In other cases, break the object into two or more smaller rectangles, Calculate the weight of each part and add them.

- **Pipe**

- Pipe calculations require actual measurements of diameter and wall thickness for accuracy.
  - Pipe sizes below 14 inches are given as nominal dimensions.
    - Example: 6-inch pipe is actually 6.75 inches in diameter.
  - Need to know actual wall thickness dimension.
- Recommendation: use a table instead of calculations.

Carbon Steel Pipe Size Chart[1]

Nom. Size (in)	O.D. (in)	Schedule Number or Weight	Wall Thickness (in)	Inside Diameter (in)	Pipe Weight (lbs/ft)
1/4	0.540	40ST	0.088	0.364	0.424
1/4	0.540	80XS	0.119	0.302	0.535
3/8	0.675	40ST	0.091	0.493	0.567
3/8	0.675	80XS	0.126	0.423	0.738
1/2	0.840	40ST	0.109	0.622	0.850
1/2	0.840	80XS	0.147	0.546	1.087
3/4	1.050	40ST	0.113	0.824	1.13
3/4	1.050	80XS	0.154	0.742	1.47
1	1.315	40ST	0.133	1.049	1.68
1	1.315	80XS	0.179	0.957	2.17
1-1/4	1.660	40ST	0.140	1.380	2.27
1-1/4	1.660	80XS	0.191	1.278	2.99
1-1/2	1.900	40ST	0.145	1.610	2.72
1-1/2	1.900	80XS	0.200	1.500	3.63
2	2.375	40ST	0.154	2.067	3.65
2	2.375	80XS	0.218	1.939	5.02
2-1/2	2.875	40ST	0.203	2.469	5.79
2-1/2	2.875	80XS	0.276	2.323	7.66
3	3.500	40ST	0.216	3.068	7.57
3	3.500	80XS	0.300	2.900	10.25
4	4.500	40ST	0.237	4.026	10.78
4	4.500	80XS	0.337	3.826	14.97
6	6.625	40ST	0.280	6.065	18.96
6	6.625	80XS	0.432	5.761	28.55
8	8.625	30	0.277	8.071	24.68
8	8.625	40ST	0.322	7.981	28.53
8	8.625	80XS	0.500	7.625	43.35
10	10.75	30	0.307	10.136	34.21
10	10.75	40ST	0.365	10.202	40.45
10	10.75	XS	0.500	9.750	54.69
10	10.75	80	0.593	9.564	64.28
12	12.75	30	0.330	12.090	43.74
12	12.75	ST	0.375	12.000	49.52
12	12.75	40	0.406	11.938	53.48
12	12.75	XS	0.500	11.750	65.37
12	12.75	80	0.687	11.376	88.44
14	14.00	30ST	0.375	13.250	54.53
14	14.00	40	0.437	13.126	63.25

Step 2: Determine what material the object is made of

- Look up the weight per unit volume for that material.

Material	Pounds per cubic foot
Aluminum	165
Concrete	150
Copper	560
Lead	710
Paper	60
Steel	490
Water	65
Wood, pine	40

Step 3: Determine weight of object

- Multiply the weight per unit volume times the calculated volume to get the calculated weight of the object.

Weight of Common Materials

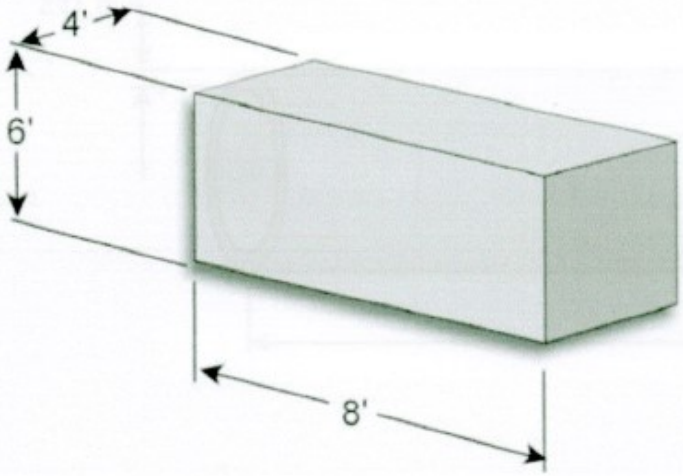
Material	lb. per cu. ft.	Material	lb. per cu. ft.
Aluminum	165	Lumber: Douglas fir	34
Asbestos, solid	153	Lumber: Oak	62
Asphalt	81	Lumber: Pine	30
Brass	524	Lumber: Poplar	30
Brick, soft	110	Lumber: Spruce	28
Brick, common red	125	Lumber: Railroad ties	50
Brick, pressed	140	Marble	98
Bronze	534	Motor oil	60
Coal	56	Paper	58
Concrete, slag	130	Petroleum: Crude	55
Concrete, reinforced	150	Petroleum: Gasoline	45
Copper	556	Portland cement (loose)	94
Diesel fuel	52	Portland cement (set)	183
Crushed rock	95	River sand	120
Earth, dry, loose	75	Rubber	94
Earth, dry, packed	95	Sand, wet	120
Earth, wet	100	Sand, dry	105
Glass	160	Sand, loose	90
Granite	96	Steel	490
Ice, solid	56	Tar	75
Iron	485	Tin	460
Lead	710	Water	63
Lime (Gypsum)	58	Zinc	437
Limestone	95		

Weights of Steel and Aluminum Plates

Examples for calculating load weight

Example #1: Rectangular Load

Object to be lifted: Concrete block, 8 feet long x 4 feet wide x 6 feet high.



• Volume of a rectangle is its length times its width times its height:

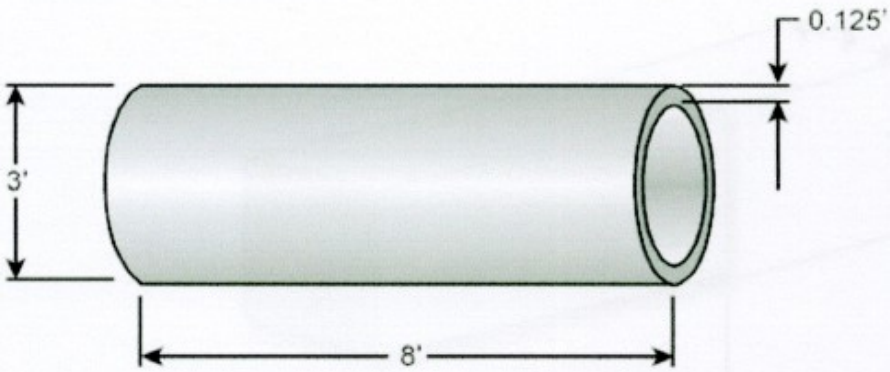
V = L x W x H = 8 ft x 4 ft x 6 ft = 192 cu ft

• Since concrete weighs 150 pounds per cu ft (see the table), the load will weigh approximately:

Block weight = 192 cu ft x 150 lbs/cu ft = 28,800 lbs

Example #2: Pipe

Object to be lifted: Hollow steel pipe, 8 ft. long x 3 ft outside diameter; wall thickness is 1.5 inches.



• Using the formula:

V = 3.14 x L x T x (D - T) = 3.14 x 8 ft x 1.5 in x (3 ft - 1.5 in)

Caution: Units not all the same: Need to convert inches to feet

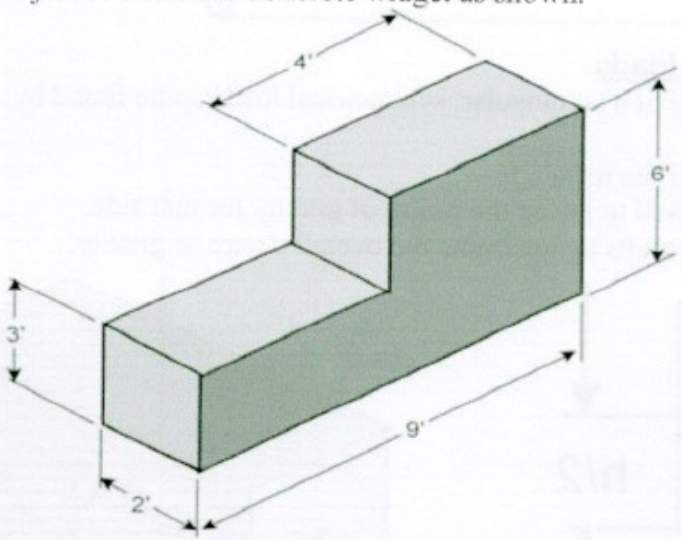
V = 3.14 x 8 ft x 0.125 ft x (3 ft - 0.125 ft) = 9.03 cu ft

• From the table, steel weighs 490 lbs/cu ft

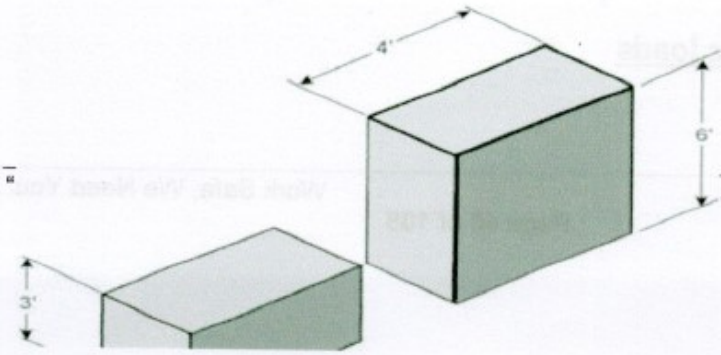
Tube weight = 9.03 cu ft x 490 lbs/cu ft = 4,425 lbs

Example #3: Complex Shapes

Object to be lifted: Concrete widget as shown.



• Cut the object into rectangles, and then calculate the weight of each section, as shown below.



- Top section

V_{top} = 2 ft x 3 ft x 4 ft = 24 cu ft

- Bottom section

V_{bottom} = 2 ft x 3 ft x 9 ft = 54 cu ft

- Total volume

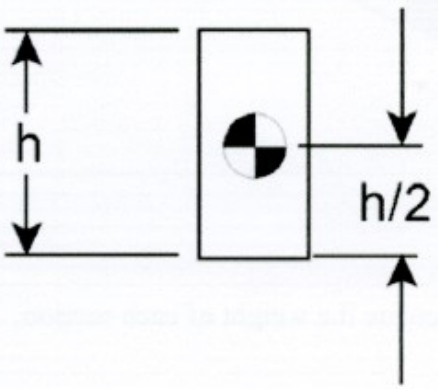
V_{total}= 24+54 = 78 cu ft

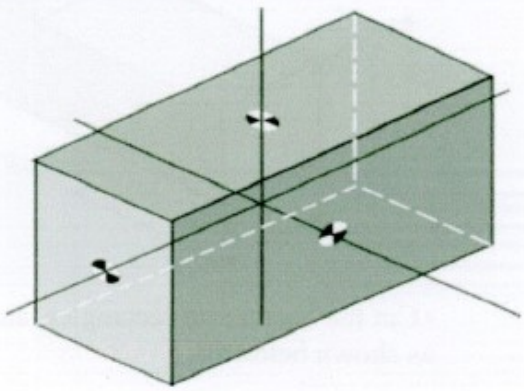
If this object were made of concrete, could it be safely lifted by a 5-ton hoist?!!

Calculating the Centre of Gravity

A. Symmetrical loads

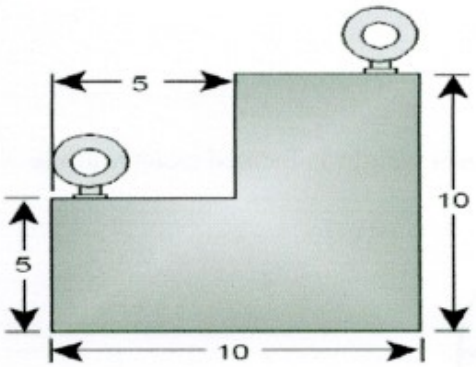
- The centre of gravity of a rectangular, symmetrical load can be found by inspection.
- Measure each side of the rectangle.
- Divide each side in half to locate the centre of gravity for that side.
- After, combine the results to determine the overall centre of gravity.

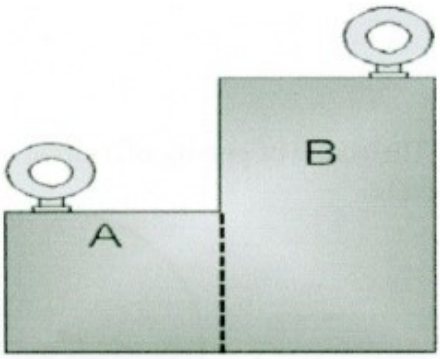




B. Asymmetric loads

• The easiest method for finding the centre of gravity of an asymmetrical load is to divide the object into rectangles and determine the centre of gravity for each first, as shown.

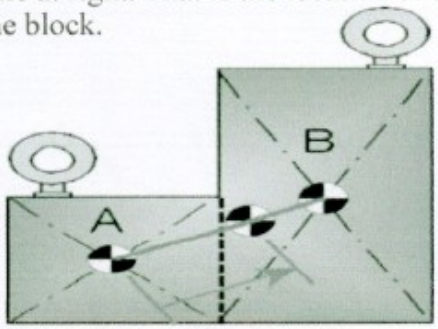




• For the example here, the left rectangle measures 5 feet by 5 feet, while the right-side rectangle measures 5 feet by 10 feet.

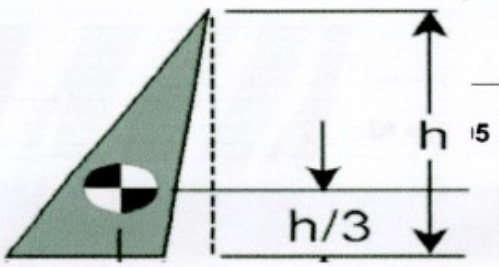
• Since the right-hand rectangle is twice as large as the smaller on the left, and since both are made of the same material, we can tell that 1/3 of the object's weight is concentrated at the left centre of gravity (labelled "A"), while 2/3 is concentrated at the right (labelled "B").

• Draw a line connecting the two centres of gravity a shown and measure 2/3 of the way from centre of gravity A to centre of gravity B, as shown by the red line at right. That is the location of the final, combined centre of gravity for the block.

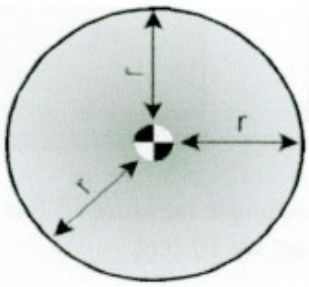


C. Other shapes

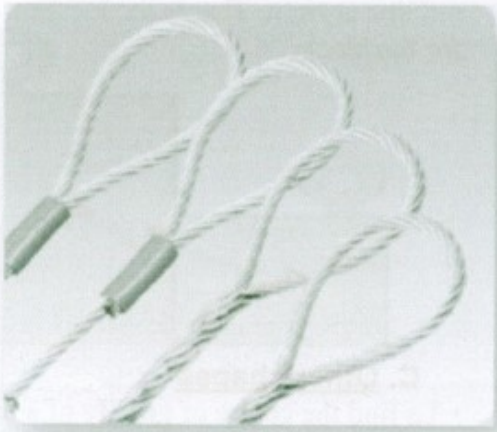
• To find the centre of gravity of a triangle, measure 1/3 the height from the base as well as 1/3 of the base from the steepest angle, as shown at right.



• The centre of gravity of a circle of uniform weight is located exactly at the centre.



Different types of slings



Textile Materials & Slings

- Flexible sling consisting of sewn webbing component for attaching loads to a hook of a crane or other lifting machine.

- **Different Materials**

The webbing shall be woven wholly from industrial yarns and certified by the manufacturer as being fast to light and heat-stabilized with a tenacity of not less than 60 cN/tex, from one of the following materials:

- Polyamide (PA), high tenacity multifilament;
- Polyester (PES), high tenacity multifilament;
- Polypropylene (PP), high tenacity multifilament.

Disposable flat woven webbing slings are suitable for use and storage at temperatures within the following ranges:

a) Polyester: -40 °C to 100 °C;

b) Polyamide: -40 °C to 100 °C;

c) Polypropylene: - 40 °C to 80 °C.

Effects of Acids & Alkalis

- **Inorganic and Organic Acids**

From a chemical point of view, polyester fibre is liable to hydrolysis. If one discounts extreme conditions, the rate of acidic hydrolysis is unexpectedly low, due to polyester having a characteristically good resistance to the majority of organic and inorganic acids.

Certain chlorine-containing organic acids have the effect of dissolving Polyester. Mono-, di- and trichloroacetic acid dissolve all polyesters at temperatures in excess of their fusion points, respectively 63°, 10° and 55°. The solution occurs rapidly at 100°C and in the case of dichloroacetic acid, this occurs even at normal room temperature.

The acidic hydrolysis of polyester is not a surface reaction, but continues to act upon the molecules throughout the entire fibre. It is followed by a reduction in the strength of the fibre and of the strain.

The reduction in the strength of the fibre varies widely depending upon the nature, the concentration and the temperature of the acid.

Residual Strength after 1-12 Months Exposure (%)

Substance	pH	1 Mth	3 Mths	6 Mths	12 Mths
Concentrated Formic Acid	0.1	100	100	100	100
Malic Acid 25%	0.1	100	100	100	100
Benzoic Acid	-	100	100	100	100
Boric Acid	3.5	100	100	100	100
Chlorosulphate Acid	-	0	0	0	0
Acetic Acid	0.1	100	100	100	100

Acetic Acid 15%	2.0	100	100	100	100
Acetic Anhydride	-	100	100	100	100
Hydrofluoric Acid 38-40%	-	97	86	70	48
Concentrated Lactic Acid	0.7	100	100	100	100
Oxalic Acid	-	100	100	100	100
Phosphoric Acid 85%	0.1	100	100	100	100
Nitric Acid 15%	0.1	100	100	100	100
Nitric Acid 65%	0.1	7	0	0	0
Hydrochloric Acid 15%	0.1	100	100	100	100
Hydrochloric Acid 37%	0.1	43.5	20	0	0
Sulphuric Acid 15%	0.1	100	100	100	100
Sulphuric Acid 38%	0.1	100	100	100	100
Concentrated Sulphuric Acid	0.1	0	0	0	0
Stearic Acid	-	100	100	100	100
Citric Acid 15%	1.5	100	100	100	100
Citric Acid 25%	1.2	100	100	100	100

The Effects of Inorganic and Organic Acids

		Breaking Strength						
Substance	**Temp C°**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**
Nitric Acid pH 0.5	20	100	100	100	99	97	96	
	60	96	89	66	30	0		
	75	70	50	0				
	100	60	0					
Sulphuric Acid pH 0.5	20	100	100	100	100	100	100	100
	50	100	100	100	100	100	97	92
	75	100	100	98	90	72	0	
	100	99	96	81	42			
		Concentration (%) of						
Substance	**Temp C°**	**2.5**	**5**	**10**	**20**	**30**		
Hydrochloric Acid pH 0.5	20	100	100	100	100	100		
	50	100	100	100	98	78		
	75	100	00	98	66	40		
	100	100	91	54	5	0		
		Concentration (%) of						
Substance	**Temp C°**	**10**	**20**	**30**	**50**	**70**		
	20	100	100	100	100	100		

Formic Acid pH 1.6	50	100	100	100	100	100
	70	100	100	100	100	100

- **The Effects of Alkalis**

Alkalis, acids or simply water can all cause the hydrolysis of polyester such as, for example, polyethylene terephthalate, but the cause of the reaction and its effect on the fibre is not the same in each case.

The effect of alkalis in an aqueous solution, with the exception of ammonia and its derivatives, is quite different, producing the progressive dissolution of the fibre, whilst water, acids, ammonia and its derivatives, e.g. quaternary ammonium bases and amines break down the fibre without dissolving it.

Calcium Hydroxide (lime)

In spite of the fact that it is possible to obtain only weak solutions of lime, its effect still seems to be 13 times more rapid than that of caustic soda under similar conditions, its effect on polyester is considerable and the loss of strength is significant.

Sodium Hyper chlorite

The resistance of polyester to sodium hyper chlorite under the conditions, to which textiles are normally exposed to it, is excellent.

Sodium Chlorite

Boiling for one hour in a 0.2% solution of sodium chlorite at pH 2-3 has no effect on the tensile strength of polyester.

Sodium Hydrosulphite

Those reducing agents which are normally used in textile processes have no noticeable effect on polyester. Treatment for 72 hours at 80°C in a saturated solution of sodium hydrosulphite causes no reduction in the strength of the fibre.

Potassium Dichromate

Polyester which has been treated for 3 days at 80°C in a saturated solution of potassium dichromate to which has been added 1% (weight/volume) of sulphuric acid exhibits a very insignificant change in its properties, the loss of strength being, for example, less than 5%.

The Effects of Alkalis

			Residual strength in % at a concentration of		
Substance	**Time in Hours**	**Temp C°**	**1%**	**3%**	**5%**
			pH 12.7	**pH 12.6**	**pH12.5**
Caustic Soda NaOH	50	20	98	94	80
	50	50	93	91	71
	50	75	85	52	12
	50	100	62	-	-

			Concentration (%) of					
Substance	**Time in Hours**	**Temp C°**	**1**	**2.5**	**5**	**10**	**20**	**25**
Ammonia HNO3	50	20	100	100	100	100	100	100
	50	50	100	100	98	95	60	55
	50	75	100	70	0	50	0	0

Colour Code (Label & Material)

Webbing width (mm)	Colourcoded according to EN 1492-1	Working Load Limit with 1 webbing sling					Working Load Limit with 2 webbing sling			
		Straight life	Choked life	β			Straight life up to 45°	Choked life up to 45°	Straight life 45°-60°	Choked life 45°-60°
				0°-7°	7°-45°	45°-60°				
		1.0	0.8	2.0	1.4	1.0	1.4	1.12	1.0	0.8
30/50	WLL 1T	1.000	800	2.000	1.400	1.000	1.400	1.120	1.000	800
60/50	WLL 2T	2.000	1.600	4.000	2.800	2.000	2.800	2.240	2.000	1.600
90/75	WLL 3T	3.000	2.400	6.000	4.200	3.000	4.200	3.360	3.000	2.400
120/100	WLL 4T	4.000	3.200	8.000	5.600	4.000	5.600	4.480	4.000	3.200
150/125	WLL 5T	5.000	4.000	10.000	7.000	5.000	7.000	5.600	5.000	4.000
180/150	WLL 6T	6.000	4.800	12.000	8.400	6.000	8.400	6.720	6.000	4.800
240/200	WLL 8T	8.000	6.400	16.000	11.200	8.000	11.200	8.960	8.000	6.400
300/250	WLL 10T	10.000	8.000	20.000	14.000	10.000	14.000	11.200	10.000	8.000

Different Sling Types

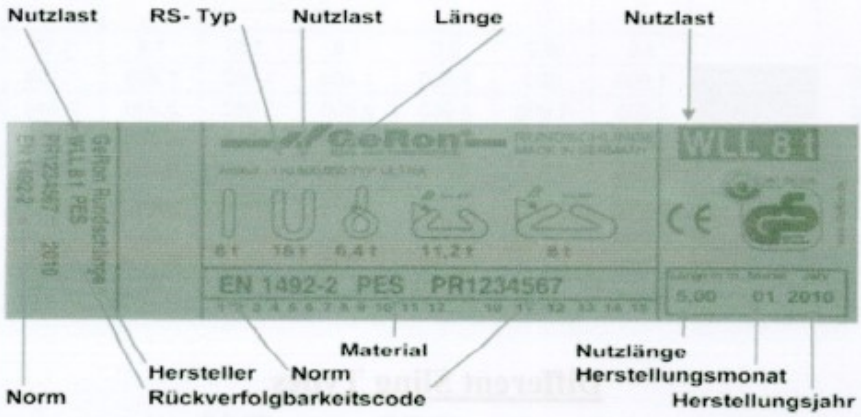
Man Made Fibre Slings

Format
- With soft becketed eyes
- With "D" links
- With "D" link and reevable link
- Endless (flat webbing)
- Endless (round sling)

Lifting modes
- Multi purpose
- Straight or basket lifts
- Straight, basket and choke lifts
- Multi purpose
- Multi purpose

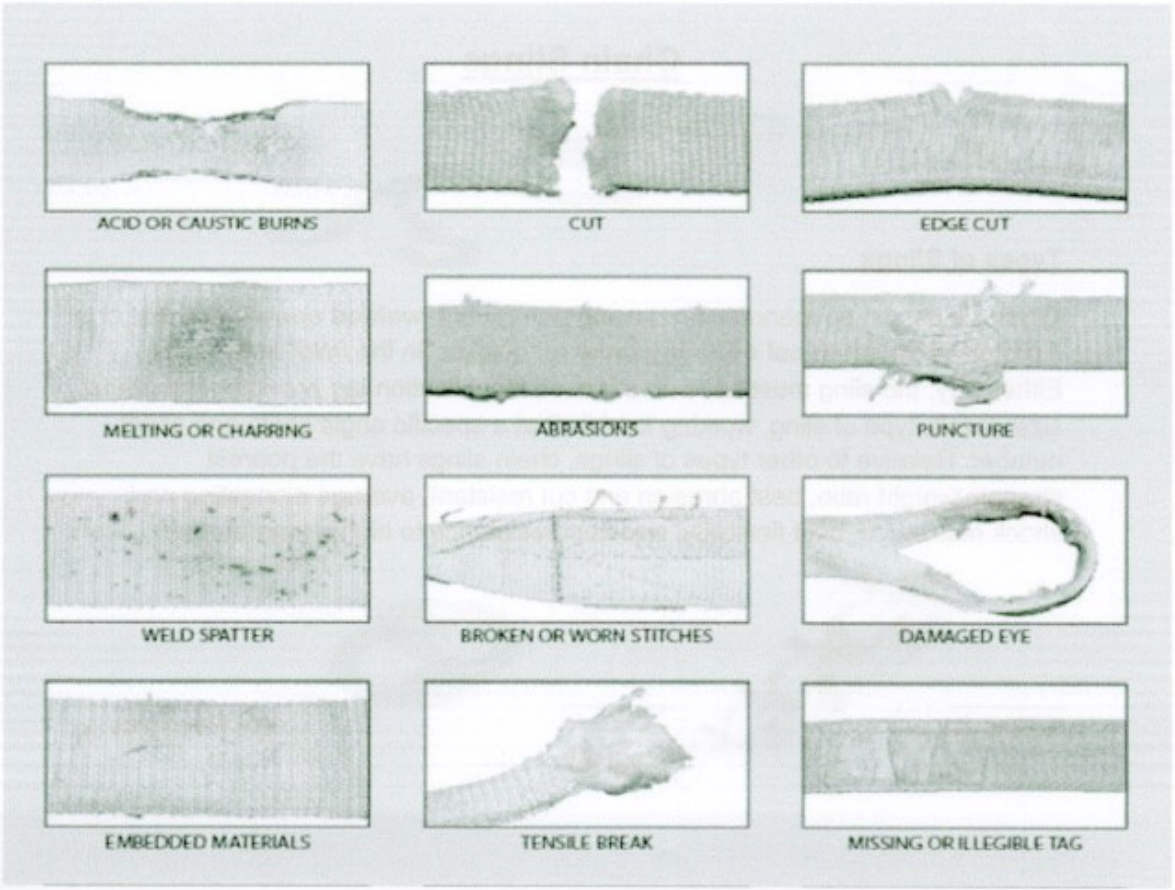
Pre Use Check

Before use, visually inspect slings and all attachments for defects. Do not use damaged or defective slings or slings that do not have a manufacturer's tag with ID No. and/or SWL.



Inspect slings daily before use and frequently during use. Slings must be removed from service when any of the following substandard conditions exist.

- Knots, snags, holes, tears, or cuts.
- Extensive abrasive wear.
- Melting or charring of any part of the sling surface.
- Visible red yarns or threads indicate excessive wear.
- Broken or worn stitches.
- Chemical damage including acid or caustic burns, brittle or stiff areas, and discoloration of any kind.
- Corrosive discoloration or other damage to fittings.
- Missing, illegible, or incomplete sling identification.



Chain Slings

Types of Slings

Chain slings can be manufactured using permanent, **welded coupling links**, or if preferred, **mechanical coupling links** for quicker "in the field" assemblies. Either way, the sling must have an attached identification tag providing the grade, size, reach, type of sling, working load limit at a specific angle of lift, and serial number. Relative to other types of slings, chain slings have the poorest strength/weight ratio, best abrasion and cut resistant, average elongation and shock resistance, best flexibility, and best resistance to high temperatures.

Welded coupling links mechanical coupling links

Materials

- Two main kinds of chain sling material (HTS & Alloy)
- Alloy steel chains are often used because of their strength, durability, abrasion resistance and ability to conform to the shape of the loads on which they are used. In addition, these slings are able to lift hot materials.

Grade marks

- New slings are marked by the manufacture to show: Size, Grade, The rated load, and Length (reach).
- In addition, slings may be marked to show: Number of legs, individual sling identification (i.e., serial number), and the name or trademark of the manufacturer.
- Alloy steel chain slings are made from various grades of alloy, but the most common grades in use are grades 80 and 100. These chains are manufactured and tested in accordance with ASTM (American Society for Testing and Materials) guidelines. If other grades of chain are used, use them in accordance with the manufacturer's recommendations and guidance.

Effects of Acids

- Chemically Active Environments can have detrimental effects on the performance of chain. The effects can be both visible loss of material

and undetectable material degradation causing significant loss of strength.

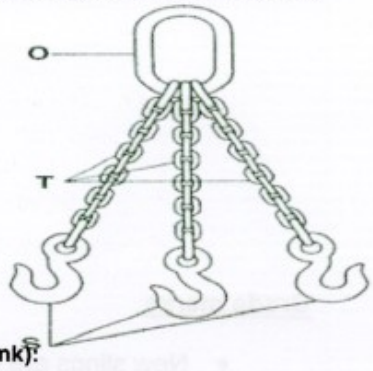
• Usage Exposure – Exposure to chemically active environments such as acids or corrosive liquids or fumes can reduce the performance of the chain.

• Special Surface Coating/Plating/Galvanizing – Chain should not be subjected to galvanizing, or any plating process.

• If it is suspected that the chain has been exposed to chemically active environment, remove from service.

Different Types

To identify the type of the chain sling we should know the main component of the chain sling which are (Construction, Master Link and Hook)



First Character (Basic Type of Construction):

S = Single leg sling
SB = Single basket
D = Double leg sling
DB = Double basket
T = Triple leg sling
SE = Single endless basket
Q = Quadruple leg sling
DE = Double endless basket
C = Single leg sling with master link at each end

Second Character (Type of Master Link or End Link):

O = Oblong master link (recommended for all assemblies)
P = Pear shaped master link (upon request only)

Third Character (Type of Hook):

S = Sling hook
G = Grab hook
F = Foundry hook

Pre Use Check

Designate a qualified person to inspect slings and all fastenings and attachments each day before use for damage or defects.

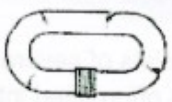
Items to look for include:

- The identification tag is missing or unreadable
- Wear;
- Defective welds,
- Nicks, cracks, breaks, gouges, stretch, bends, discoloration due to excessive heat,
- Excessive pitting or corrosion,
- Throat opening of hooks,
- Missing or illegible sling identifications, and
- Other conditions that cause doubt as to continued safe use of the sling.

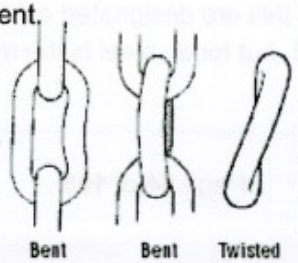
Make a link-by-link inspection and discard if:

a) Wear exceeds 15% of a link diameter.

b) Cut, nicked, cracked, gouged, burned, or corrosion pitted.

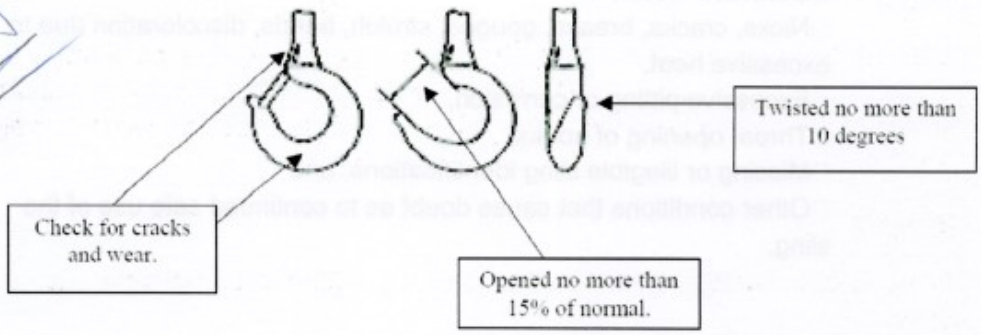


c) Twisted or bent.



d) Stretched. Links tend to close up and get longer.

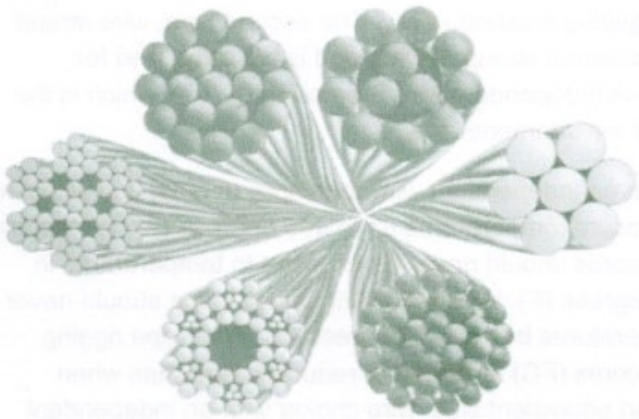
- Check master link, load pins and hooks for any of the above faults. Hooks should be removed from service if they have been opened more than 15% of the normal throat opening, measured at the narrowest point, or twisted more than 10° from the plane of the unbent hook.

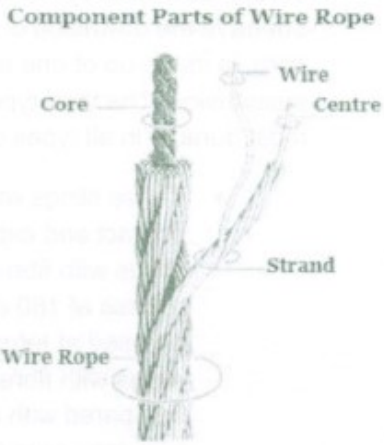


Steel Wire Rope Slings

Wire rope is a type of cable which consists of several strands of metal wire laid (twisted) into a helix. The term cable is often used interchangeably with wire rope. However, in general, "wire rope" refers to diameters larger than 3/8 inch (3.6 mm). Sizes smaller than this are designated cable or cords.[1] Initially wrought iron wires were used, but today steel is the main material used for wire ropes.

Manufacture





Wires

Steel wires for wire ropes are normally made of non-alloy carbon steel with a carbon content of 0.4 to 0.95%. The very high strength of the rope wires enables wire ropes to support large tensile forces and to run over sheaves with relatively small diameters.

Strands

In the so-called cross lay strands, the wires of the different layers cross each other.

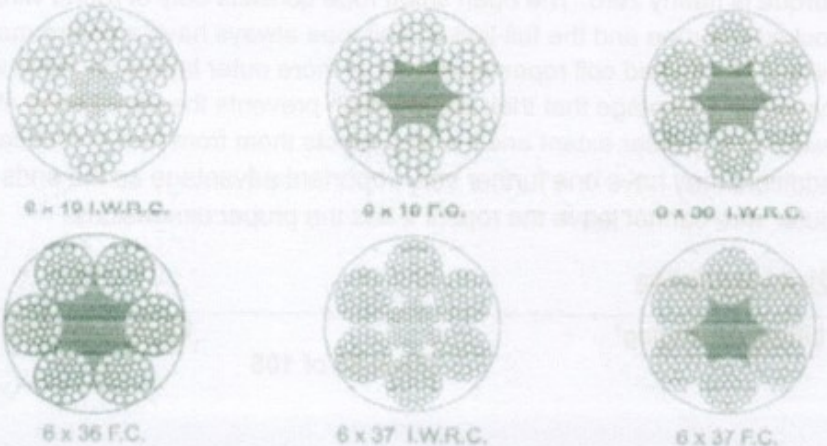
Spiral ropes

In principle, spiral ropes are round strands as they have an assembly of layers of wires laid helically over a centre with at least one layer of wires being laid in the opposite direction to that of the outer layer. Spiral ropes can be dimensioned in such a way that they are non-rotating which means that under tension the rope torque is nearly zero. The open spiral rope consists only of round wires. The half-locked coil rope and the full-locked coil rope always have a centre made of round wires. The locked coil ropes have one or more outer layers of profile wires. They have the advantage that their construction prevents the penetration of dirt and water to a greater extent and it also protects them from loss of lubricant. In addition, they have one further very important advantage as the ends of a broken outer wire cannot leave the rope if it has the proper dimensions.

Stranded ropes

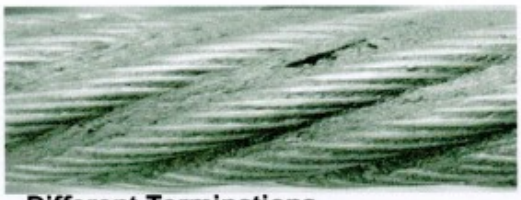
Stranded ropes are an assembly of several strands laid helically in one or more layers around a core. This core can be one of three types. The first is a fiber core, made up of synthetic material. Fiber cores are the most flexible and elastic, but have the downside of getting crushed easily. The second type, wire strand core, is made up of one additional strand of wire, and is typically used for suspension. The third type is independent wire rope core (IWRC), which is the most durable in all types of environments.

- These slings with an independent wire rope core (IWRC) can withstand contact and exposure temperatures up to 400 degrees (F). Wire cable slings with fibre cores should never be exposed to temperatures in excess of 180 degrees (F). Wire rope slings of all types should never be used at temperatures below -40 degrees (F). Wire rope rigging slings with fibre cores (FC) are rated at reduced capacities when compared with an equivalent size, wire choker with an independent wire rope core (IWRC). Wire Rope Slings are generally fabricated from 6 x 19 or 6 x 37 construction wire cable. The constructional numbers refer to the number of strands (6) that are helically wound around a core. The core supports the strands of the wire rope lifting sling and can either be an independent wire rope core (IWRC) or a fibre core (FC) made from hemp or sisal. Smaller diameter wire rope slings feature 6 strands with 19 wires in each strand. Larger diameter industrial lifting slings will generally feature 6 strands with 37 individual wires in each strand. The 6 x 37 construction is more flexible than the 6 x 19 construction, but not as abrasion resistant. Wire cable lifting slings used by the crane, rigging and material handling industries are available in many different styles and constructions to meet your needs. Custom made slings and special order slings are shipped daily from our factory. The most popular wire lifting slings are Single Body slings featuring a 6 x 19 or 6 x 37 Construction, Extra Improved Plow Steel (EIPS) Wire Rope with an Independent Wire Rope Core (IWRC).



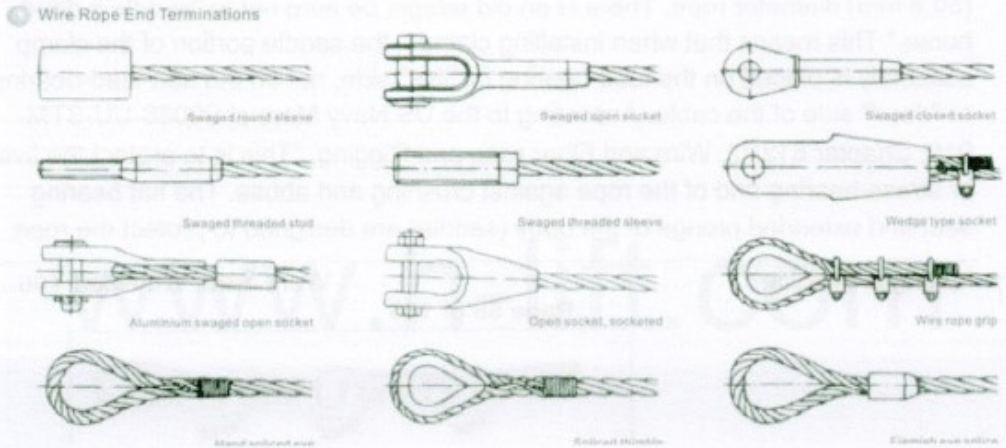
Lays (Ordinary & Lang's)

Most types of stranded ropes only have one strand layer over the core (fibre core or steel core). The lay direction of the strands in the rope can be right (symbol Z) or left (symbol S) and the lay direction of the wires can be right (symbol z) or left (symbol s). This kind of rope is called ordinary lay rope if the lay direction of the wires in the outer strands is in the opposite direction to the lay of the outer strands themselves. If both the wires in the outer strands and the outer strands themselves have the same lay direction, the rope is called a Lang lay rope (formerly Albert's lay or Lang's lay). Multi-strand ropes are all more or less resistant to rotation and have at least two layers of strands lay helically around a centre. The direction of the outer strands is opposite to that of the underlying strand layers. Ropes with three strand layers can be nearly non-rotating. Ropes with two strand layers are mostly only low-rotating.



Different Terminations

The end of a wire rope tends to fray readily, and cannot be easily connected to plant and equipment. There are different ways of securing the ends of wire ropes to prevent fraying. The most common and useful type of end fitting for a wire rope is to turn the end back to form a loop. The loose end is then fixed back on the wire rope. Termination efficiencies vary from about 70% for a Flemish eye alone; to nearly 90% for a Flemish eye and splice; to 100% for potted ends and swaging.



Thimbles

When the wire rope is terminated with a loop, there is a risk that it will bend too tightly, especially when the loop is connected to a device that spreads the load over a relatively small area. A thimble can be installed inside the loop to preserve the natural shape of the loop, and protect the cable from pinching and abrading on the inside of the loop. The use of thimbles in loops is industry best practice. The thimble prevents the load from coming into direct contact with the wires.

Wire rope clamps/clips

A wire rope clamp, also called a clip, is used to fix the loose end of the loop back to the wire rope. It usually consists of a U-shaped bolt, a forged saddle and two nuts. The two layers of wire rope are placed in the U-bolt. The saddle is then fitted over the ropes on to the bolt (the saddle includes two holes to fit to the U-bolt). The nuts secure the arrangement in place. Three or more clamps are usually used to terminate a wire rope. As many as eight may be needed for a 2 in (50.8 mm) diameter rope. There is an old adage; be sure not to "saddle a dead horse." This means that when installing clamps, the saddle portion of the clamp assembly is placed on the load-bearing or "live" side, not on the non-load-bearing or "dead" side of the cable. According to the US Navy Manual S9086-UU-STM-010, Chapter 613R3, Wire and Fiber Rope and Rigging, "This is to protect the live or stress-bearing end of the rope against crushing and abuse. The flat bearing seat and extended prongs of the body (saddle) are designed to protect the rope

and are always placed against the live end."[13] The US Navy and most regulatory bodies do not recommend the use of such clips as permanent terminations.

Swaged terminations

Swaging is a method of wire rope termination that refers to the installation technique. The purpose of swaging wire rope fittings is to connect two wire rope ends together, or to otherwise terminate one end of wire rope to something else. A mechanical or hydraulic swagger is used to compress and deform the fitting, creating a permanent connection. There are many types of swaged fittings. Threaded Studs, Ferrules, Sockets, and Sleeves are a few examples. Swaging ropes with fiber cores is not recommended.

Wedge sockets

A wedge socket termination is useful when the fitting needs to be replaced frequently. For example, if the end of a wire rope is in a high-wear region, the rope may be periodically trimmed, requiring the termination hardware to be removed and reapplied. An example of this is on the ends of the drag ropes on a dragline. The end loop of the wire rope enters a tapered opening in the socket, wrapped around a separate component called the wedge. The arrangement is knocked in place, and load gradually eased onto the rope. As the load increases on the wire rope, the wedge becomes more secure, gripping the rope tighter.

Potted ends or poured sockets

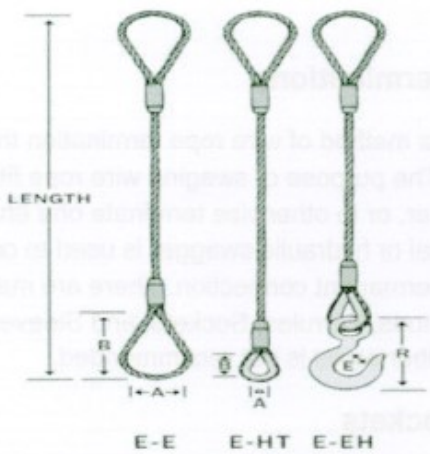
Poured sockets are used to make a high strength, permanent termination; they are created by inserting the wire rope into the narrow end of a conical cavity which is oriented in-line with the intended direction of strain. The individual wires are splayed out inside the cone, and the cone is then filled with molten zinc, or now more commonly, an epoxy resin compound.

Eye splice or Flemish eye

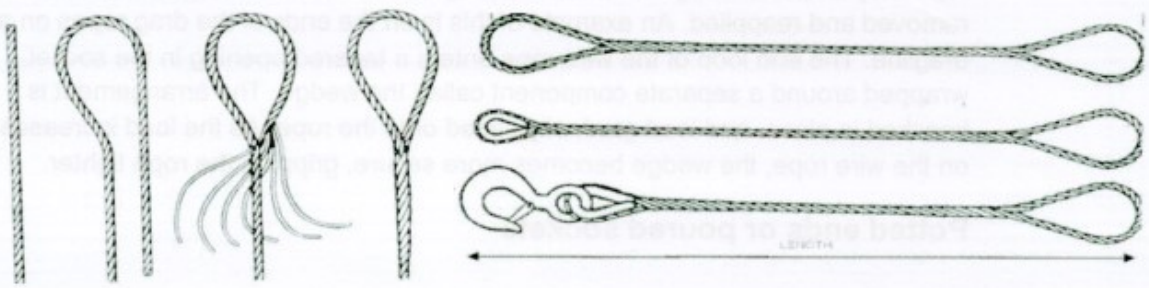
An eye splice may be used to terminate the loose end of a wire rope when forming a loop. The strands of the end of a wire rope are unwound a certain distance, and plaited back into the wire rope, forming the loop, or an eye, called an eye splice. When this type of rope splice is used specifically on wire rope, it is called a "Molly Hogan", and, by some, a "Dutch" eye instead of a "Flemish" eye.

Different Types of Steel Wire Rope Slings

•Mechanical Straight Slings.



•Hand spliced slings.

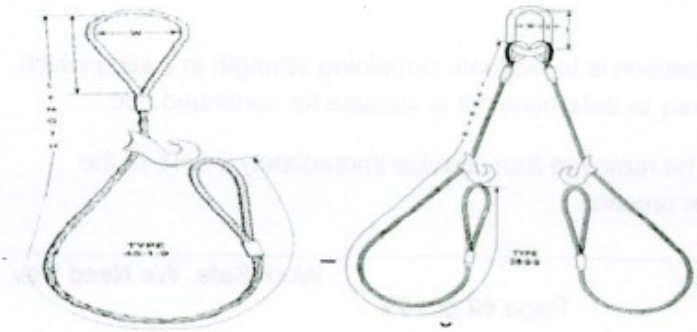


•Single Leg Slings.

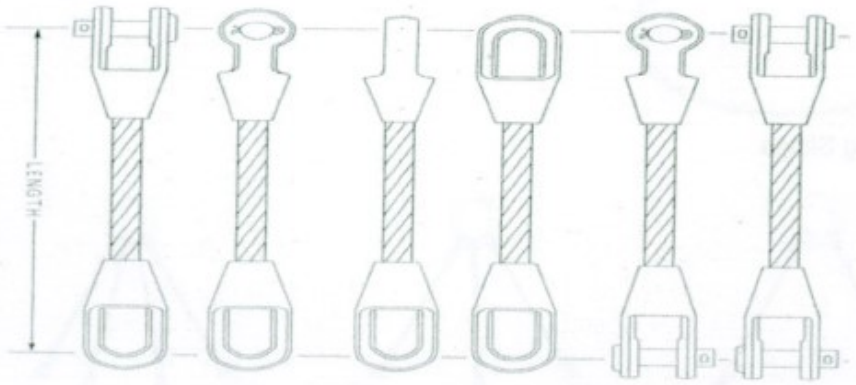
•Multi-leg Slings.

• Braided Slings.

•Basket Hitch Slings.



•Swaged Socket Slings.



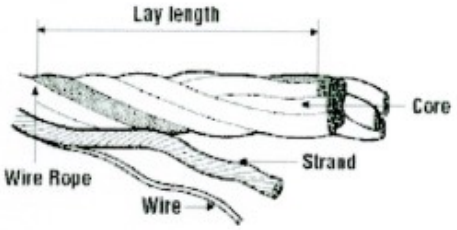
•Endless Slings / Round Slings.

Pre Use Check

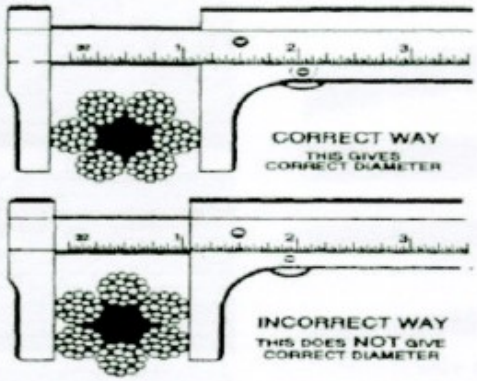
The goal of a sling inspection is to evaluate remaining strength in a sling which has been used previously to determine if it is suitable for continued use.

A wire rope sling shall be removed from service immediately if ANY of the following conditions are present:

Broken Wires: For sing part slings, 10 randomly distributed broken wires in one rope lay, or five broken wires in one strand of one rope lay. For multi part slings these same criteria apply to each of the component ropes. For this inspection, a broken wire shall only be counted once that is, each break should have two ends.

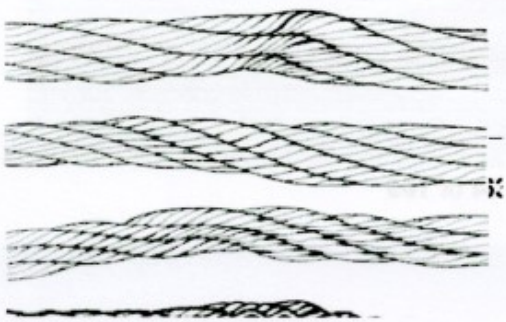


Metal Loss: Wear or scraping of one third the original diameter of outside individual wires. This is quite difficult to determine on slings an experience should be gained by the inspector by taking apart old slings and actually measuring wire diameters.

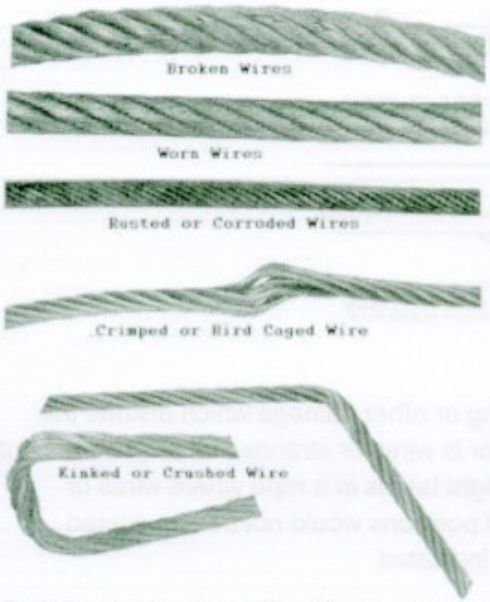


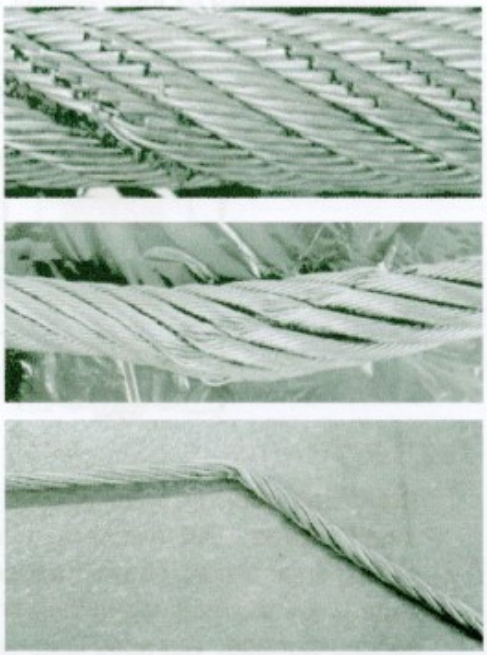
Distortion: Kinking, crushing, bird caging or other damage which distorts the rope structure. The main thing to look for is wires or strands that are pushed out of their original positions in the rope. Slight bends in a rope where wires or strands are still relatively in their original positions would not be considered serious damage. But good judgment is indicated.

Metal Corrosion: Severe Corrosion of the rope or end attachments which has caused pitting or binding of wires should be cause for replacing the sling. Light rusting usually does not affect strength of a sling, however

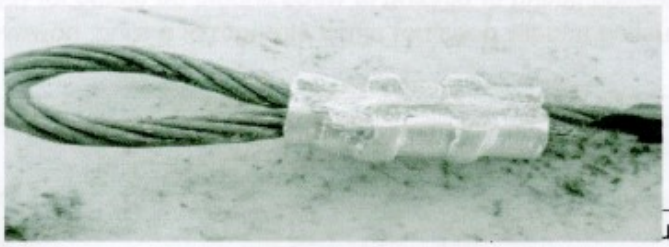


Typical Rope Damage





Bad End Attachments: Cracked, bent or broken end fit tings caused by abuse, wear or accident.



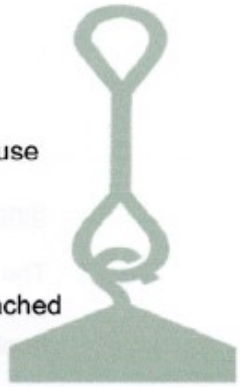
Bent hooks: No more than 15 percent over the normal throat openings, measured at the narrowest point, or twisting more than 10 degrees is permissible.

Sling Configurations

How wire rope slings are configured to lift a load is called a hitch. Most lifts use one of three basic hitches.

Straight Pull (Vertical Eye and Eye Hitch):

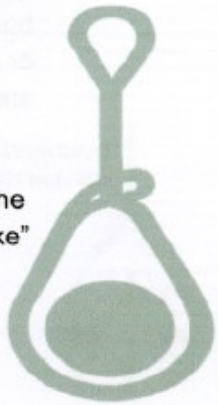
If one eye of the sling is attached to the lifting hook and the other eye is attached to the load, this is called a vertical eye and eye, or straight, hitch. A tagline should be used to prevent load rotation that may damage the sling.



When two or more slings are attached to the same lifting hook, the total hitch becomes, in effect, a lifting bridle and the load is distributed equally among the individual slings.

Choker Hitch

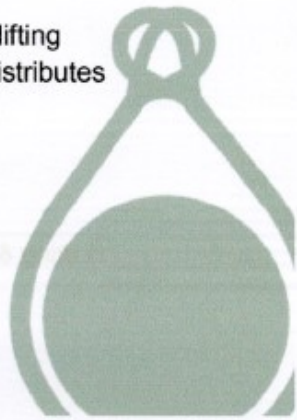
In the choker hitch, one eye of the sling is attached to the lifting hook, while the sling itself is drawn through the other eye. The load is placed inside the "choke" that is created while the sling is drawn tight over the load through the eye.

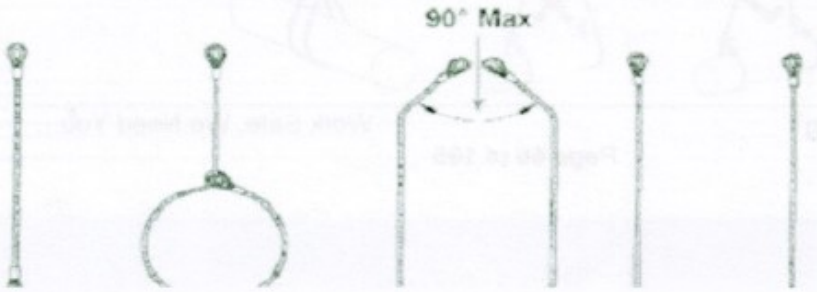


Choker hitches reduce the lifting capability of a sling since the wire rope component's ability to adjust during the lift is affected.

Basket Hitch

A basket hitch is formed when both eyes of the sling are placed on the lifting hook, thereby forming a circular basket of the sling. This type of hitch distributes the load equally between the two legs of the sling, within limitations.

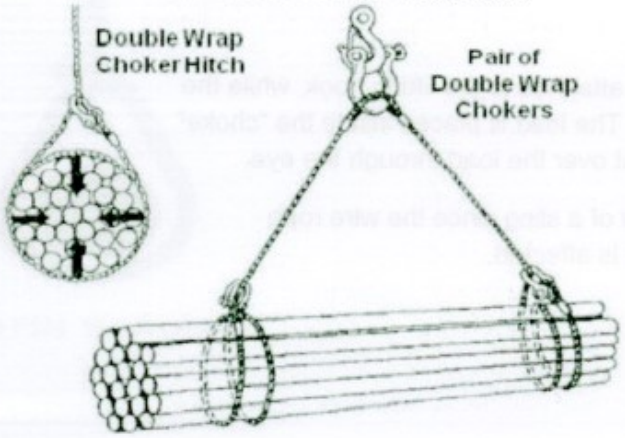




Single & Double Wrap

The single Wrap hitch is used to support a load by attaching one end of the sling to the hook, then passing the other end under the load and attaching it to the hook. One shall ensure that the load does not slide along the sling during lifting.

The double wrap basket hitch is a basket hitch wrapped completely around the load and compressing it rather than merely supporting it, as done by the ordinary basket hitch. The double wrap basket hitch can be used in pairs like the double basket hitch. This arrangement is used for handling loose material, pipes, rods, or a smooth cylindrical load because the sling is in full 360° contact with the load and tends to draw it together.



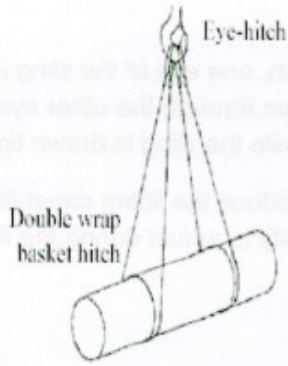


Figure 4

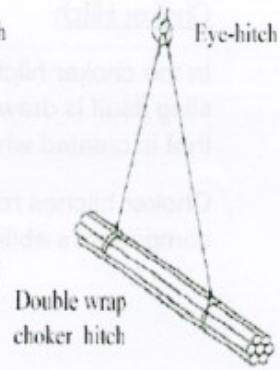
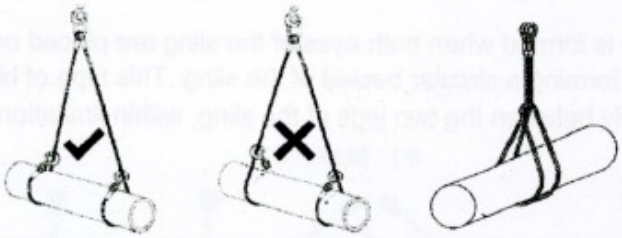


Figure 5



Advantages / Disadvantages of different Sling types

The most commonly used slings used for overhead lifting applications are:

1. Wire Rope Slings
2. Chain Slings
3. Nylon Slings
4. Polyester Slings

Each sling has its advantage and disadvantages. Provided below is a quick overview of these differences:

1. Wire Rope Slings

Advantages: Compared to chain slings these slings are lighter and much cheaper. Wire rope slings are available in longer lengths than any other type of sling listed here. They utilize multiple strands of wire which are twisted together to form a thicker wire rope. There can be as many as 150 individual strands which all help to carry weight within the sling. So just in case one individual strand is damaged, the other 149 will continue to hold the load secure.

Disadvantages: Wire rope slings are flexible only to some degree. While these slings do curve, these slings will deform if bent too far. If a wire rope snaps it can take on the characteristics of a whip and injure or kill an operator. Wire ropes are more lightweight than chain slings but are much heavier than synthetic slings like nylon or polyester. Wire rope slings require more work for the operator to carry and install.

2. Chain slings

Advantages: Compared to any other sling listed here chain slings are the most durable slings. Because of their extreme durability, they tend to last much longer than other types of slings. They are flexible and are available with a variety of fittings and configuration set-ups.

Disadvantages: Compared to any other sling listed here, chain slings are much more expensive on a capacity and per foot basis. The slings are also much heavier than any other sling. These slings are extremely heavy to carry, transport and install.

3. **Nylon Slings**

Advantages: Nylon slings are very flexible and do not scratch loads. Compared to chain or wire rope, the slings can be used in a choker hitch with relative ease. Nylon is an extremely cheap raw material. If a nylon sling snaps and breaks, it generally does not whip with the same force as a traditional sling and the slings are consequently safest to operators and bystanders.

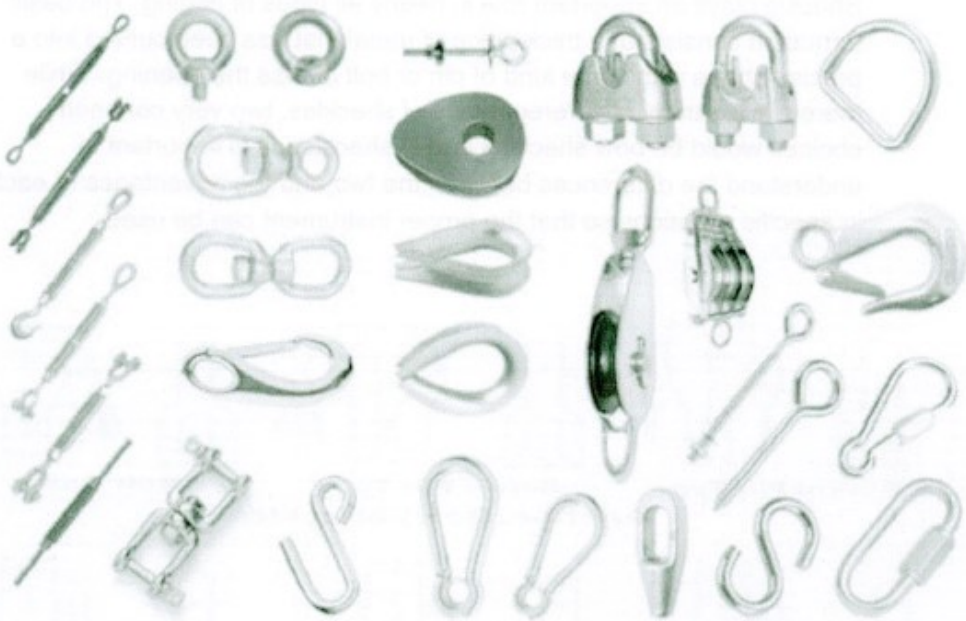
Disadvantages: Nylon slings are subject to abrasions and get cut easily. Consequently nylon slings have a short life if used frequently.

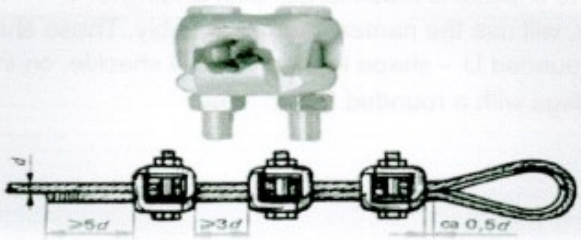
4. **Polyester Slings**

Advantages: Polyester slings have the same advantages as Nylon slings. In addition polyester slings are even softer and more flexible. The price of polyester slings is approximately the same as nylon slings on a capacity and per foot basis.

Disadvantages: Polyester slings have the same disadvantages as nylon slings.

Different types of lifting accessories

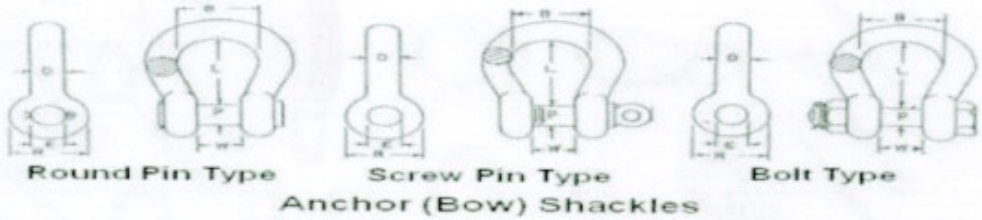




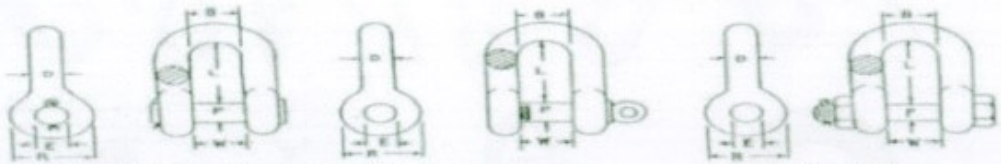
Shackles

- **Dee & Bow**

Shackle plays an important role in nearly all types of rigging. The basic formation consists of a thick piece of metal that has been curved into a precise shape with some kind of pin or bolt across the opening. While there are a variety of different types of shackles, two very common choices would be bow shackles and D shackles. It is important to understand the differences between the two and the advantages of each in specific situations so that the proper instrument can be used.



Anchor (Bow) Shackles



Chain (Dee) Shackles

A bow shackle looks similar to an anchor shackle except that the bowed part of the shackle is much larger than an anchor shackle. Some, however, will use the names interchangeably. These shackles have an almost rounded U – shape to them. The D shackle, on the other hand has straight legs with a rounded top.

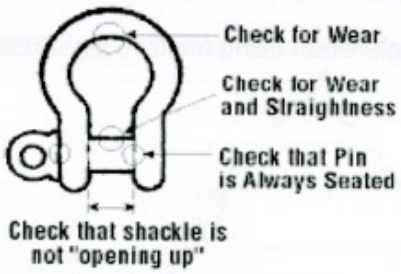
- **Uses**

Each type of shackle has specific uses where it works best. The way that the bow shackle is designed, it is able to handle a variety of types of loads in most directions without too much difficulty. Each shackle is typically rated with a weight limit, and different angled loads will have different ratio of that capacity. For a bow shackle, if they are going to be used intensively it is important to verify that the item has been forged so it is as reliable as possible. Some variations of this shape are simply cast from stainless steel, making them unsuitable for many types of rigging. Bow shackles are often made of stainless steel or titanium. It is important to note that the larger loop does D Shackles weaken the strength of the overall shackle, but the size also allows for a larger strap.

The D shackle is limited a bit in the way it can handle a load. The small loop at the top can typically handle something heavy, but side loads or racking loads may bend D shackles. For this reason, they are most typically used in bidirectional load situations. Since the loop at the top of the shackle is rather small, the pieces is typically capable of handling a significant weight, but always verify restrictions on a particular piece before use.

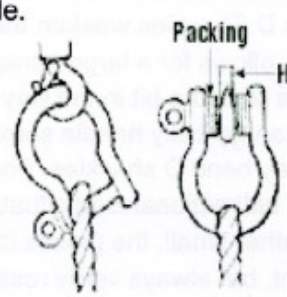
- **Pre Use Check**

•Inspect shackles regularly.
•Inspect the shackle eye and pin holes for stretching (elongation) and wear. Elongation means the metal is being overloaded.
•Inspect the shackle body for bending. A bent shackle indicates excessive side-loading.
•Inspect all shackle pins for distortion, surface blemishes, wear and fractures.
•All pins must be straight and all screw pins must be completely seated.
•Replace shackles that are bent, show excessive wear by more than 10% of the original diameter, or have an elongated eye or shackle pin holes.



•Do not replace the shackle pin with a bolt or unidentified pins. A load will bend the bolt.

•Do not allow a shackle to be pulled at an angle. The legs will open. Pack the pin with washers to center the shackle.



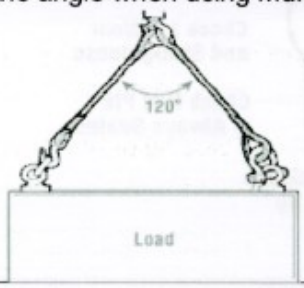
•Do not use screw pin shackles or fit pins in contact with moving parts if the pin can roll and unscrew. If the load shifts, the sling will unscrew the shackle pin.

•Do not use round pin shackles restrained only by a cotter pin for overhead lifting.

•Do not use shackles with bent pins or deformed bodies.

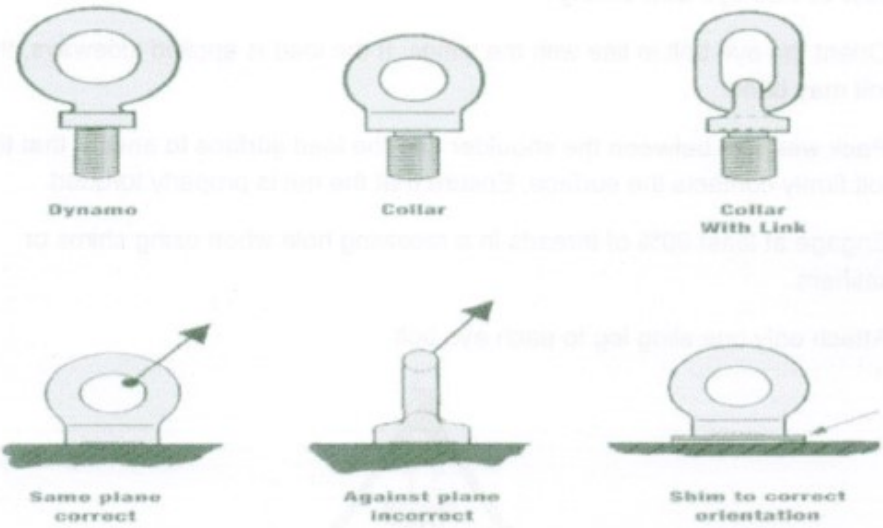
•Do not force, hammer or wedge shackles into position.

•Do not exceed 120 degrees for the angle when using multiple leg slings.



Eyebolts

- **Eye Bolt types**



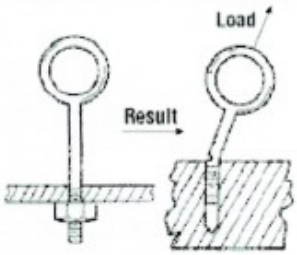
- **Uses & Restrictions**

Eye bolts are marked with their thread size NOT with their rated capacities. Make sure you select the correct eyebolt based on its type and capacity for the lift you are conducting.

•Use plain or regular eye bolts (non-shoulder) or ring bolts for vertical loading only. Angle loading on non-shoulder bolts will bend or break them.

•Use shoulder eye bolts for vertical or angle loading. Be aware that lifting eye bolts at an angle reduces the safe load.

•Follow the manufacturer's recommended method for angle loading.



Incorrect use of shoulder bolt applied

Shoulder eye bolt with load correctly

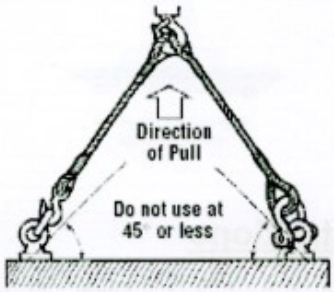
How to use eye bolt safely?

•Orient the eye bolt in line with the slings. If the load is applied sideways, the eye bolt may bend.

•Pack washers between the shoulder and the load surface to ensure that the eye bolt firmly contacts the surface. Ensure that the nut is properly torqued.

•Engage at least 90% of threads in a receiving hole when using shims or washers.

•Attach only one sling leg to each eye bolt.



•Inspect and clean the eye bolt threads and the hole.

•Screw the eye bolt on all the way down and properly seat.

•Ensure the tapped hole for a screw eye bolt (body bolts) has a minimum depth of one-and-a-half times the bolt diameter.

•Install the shoulder at right angles to the axis of the hole. The shoulder should be in full contact with the surface of the object being lifted.

•Use a spreader bar with regular (non-shoulder) eye bolts to keep the lift angle at 90° to the horizontal.

◦Use eye bolts at a horizontal angle greater than 45°. Sling strength at 45° is 71% of vertical sling capacity, eye bolt strength at 45° horizontal angle drops down to 30% of vertical lifting capacity.

◦ Use a swivel hoist ring for angled lifts. The swivel hoist ring will adjust to any sling angle by rotating around the bolt and the hoisting eye pivots 180°.

What should you avoid when using eye bolts?

•Do not run a sling through a pair of eye bolts: this will reduce the effective angle of lift and will put more strain on the rigging.

•Do not force the slings through eye bolts. This force may alter the load and the angle of loading.

•Do not use eye bolts that have been ground, machined or stamped.

•Do not use bars, grips or wrenches to tighten eye bolts.

•Do not paint an eye bolt. The paint could cover up flaws.

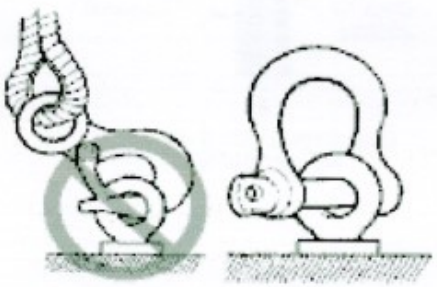
•Do not force hooks or other fittings into the eye; they must fit freely.

•Do not shock load eye bolts.

•Do not use a single eye bolt to lift a load that is free to rotate.

•Do not use eye bolts that have worn threads or other flaws.

•Do not insert the point of a hook in an eye bolt. Use a shackle.



- **Pre Use Check**

1. Ensure the WLL is clearly legible.

2. Clean eyebolt and check for any signs of deformation, cracking, nicks, gouges and excessive bruising, wear or corrosion.

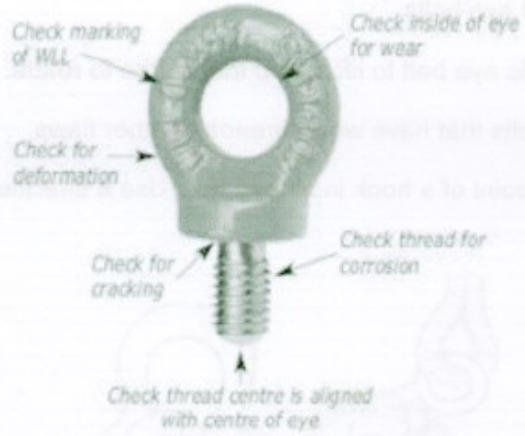
3. Threads should be concentric and fit neatly into a standard nut.

4. Check that the centre line of the eye is aligned with the centre line of the thread.

5. The threaded hole in which the eyebolt is to be fitted should also be carefully checked to ensure the hole is free from dirt, grease and other contaminants that could restrict the eyebolts from seating correctly in the hole. Particular attention should be paid to the hole thread to ensure it is in good condition.

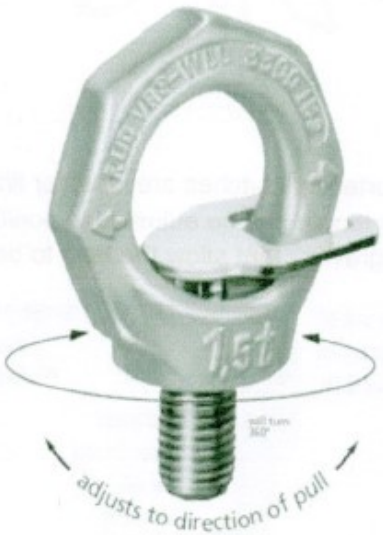
6. Check that the hole thread and the eyebolt thread are compatible.

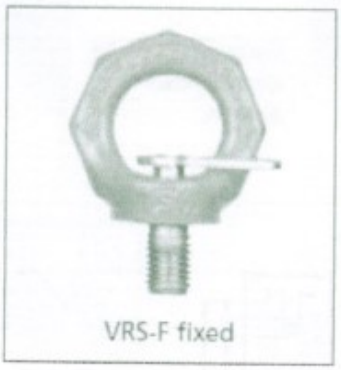
7. It is important to also carefully check the surface area around the threaded hole (which the eyebolt collar will sit on) to ensure it is clean, free from deformation, cracking or any other problem that may restrict the eyebolt seating correctly.

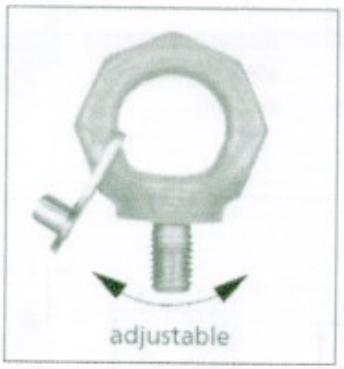


- **Star eyebolt**

- The Star eyebolt is the perfect solution to eliminate the unsafe and rigid style eye bolt.
- Safety factor 4:1 in any direction.
- Marked working load limits (WLL) are rated at 90° from thread.
- The Star eyebolt is rotatable!

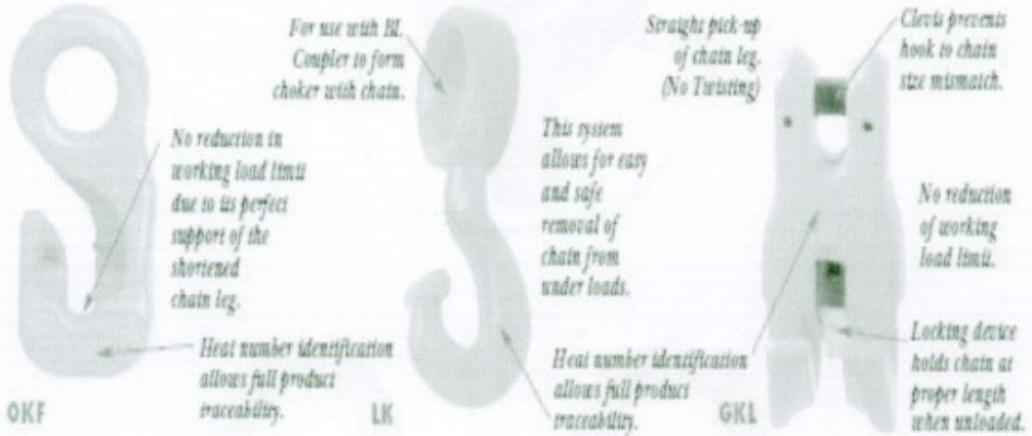


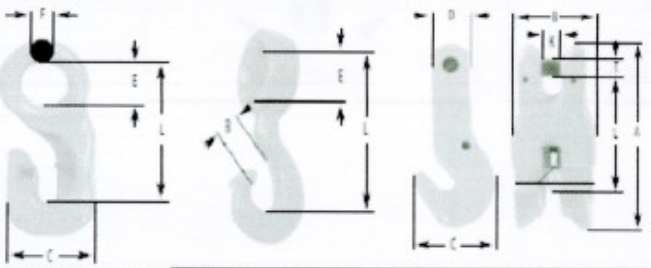




Shortening Clutches

Chain slings fitted with shortening clutches are ideal for lifting loads with an offset centre of gravity as the leg length can be adjusted to position the lifting ring directly over the centre of gravity , that allow the load to be lifted level.





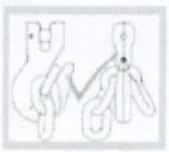


Figure 1

Figure 2

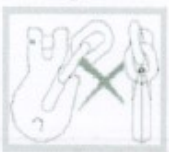


Figure 4

Figure 3

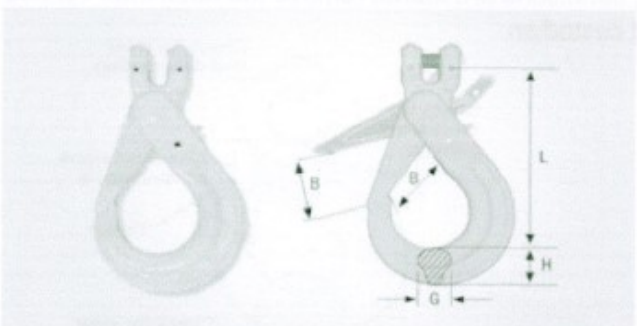
Hooks

A lifting hook is a device for grabbing and lifting loads by means of a device such as a hoist or crane. A lifting hook is usually equipped with a safety latch to prevent the disengagement of the lifting wire rope sling, chain or rope to which the load is attached.

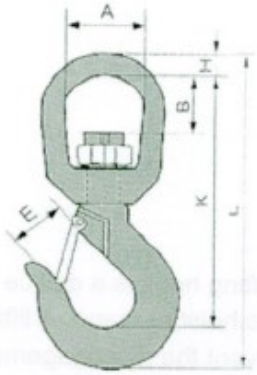
- **Types**

Lifting hooks safety latch

Safety hooks



Swivel hooks



- **Pre Use Check**

The operator or other designated person must visually inspect hooks daily or prior to first use, or if the hook is not in regular service for

–Cracks, nicks, gouges

–Deformation

–Damage from chemicals

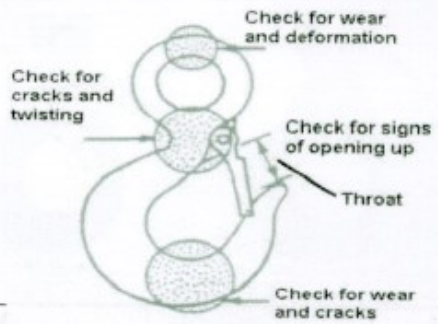
–Damage, engagement, or malfunction of latch (if provided)

–Evidence of heat damage

–Wear

–Hook attachment and securing means

If any of these conditions are found, remove the hook from service and contact the equipment custodian.



Hook with Safety Latch

Rigging Screws (Turnbuckles)

- **Turnbuckle End Fittings**

Jaw And Eye
(Most Popular)

Eye And Eye

Jaw And Jaw

Hook And Eye

Hook And Hook

Stub Ends

- **Uses**

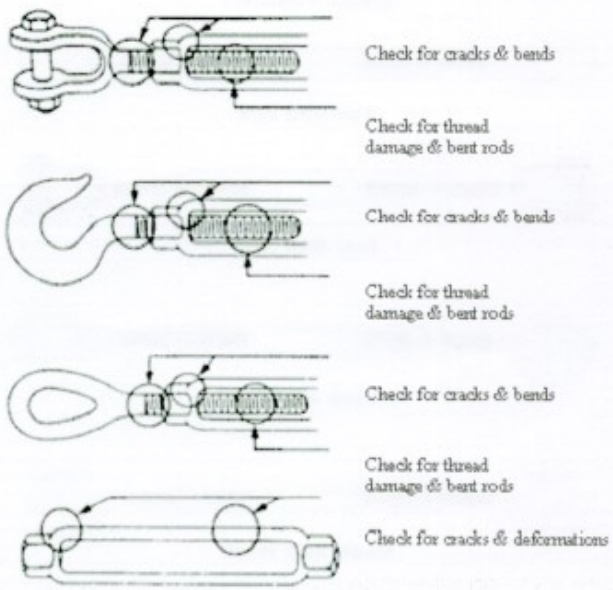
The principles of the operation of the turnbuckle is to have the screws operating clockwise and counter clockwise to close the eye or opening between two steel products or barrels.

Turnbuckles are most commonly used in applications which require a great deal of tension.

When tightening a turnbuckle don't apply more torque than you would to a bolt of equal size.

- **Pre Use Check**

Inspect turnbuckles frequently for cracks in end fittings (especially at the neck of the shank), deformed end fittings, deforming and bent rods and bodies, cracks and bends around internally threaded portion, and signs of thread damage.



Wire Rope Grips

- **Types**

Commercial grade wire rope grips:

Not for lifting applications, manufactured to duty applications, usually supplied in electroplated finish.

Stainless-steel wire rope grips:

Not to be used for lifting, these grips are not produced to any standard.

Double base wire rope grips:

Are commonly used for a higher grip hold of the wire rope, also with the double base the grip tends not to damage in case it requires lengthening.

- **Uses**

Wire rope grips are used on wire rope eye-loop connections or complete loops, end-to-end connections where socketing or splicing is not feasible or when a temporary joint is required.

The incorrect selection or fitting of Wire Rope Grips drastically reduces the efficiency of the wire rope terminations and can permit the wire rope to slip through the Grips, leading to collapse of the equipment.

Wire rope grips should not be used in lifting applications or rope terminations on load suspension devices that are used for lifting.

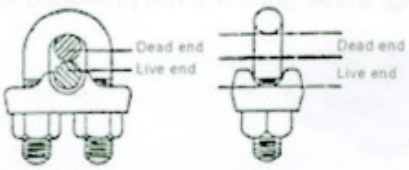
Wire rope grips should not be used for making terminations on live running ropes nor where a rope is required to support persons or suspended loads.

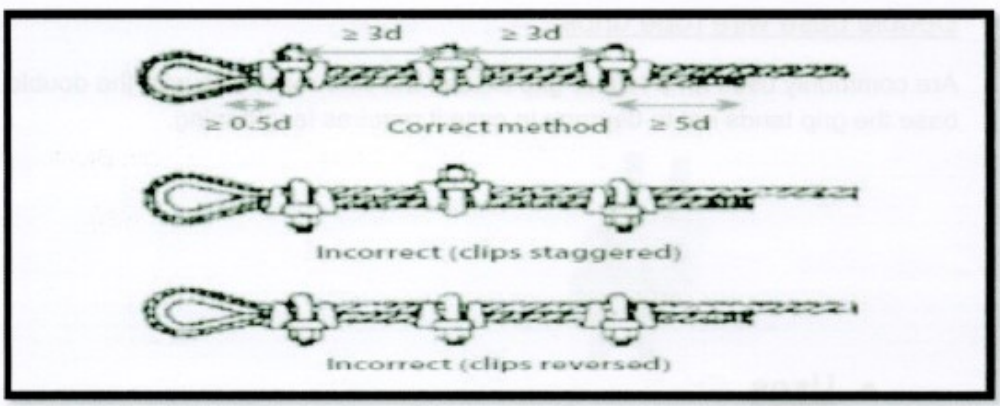
- **Correct Fitment**

A number of factors can adversely affect the tightness of the grips on ropes, such as:

- The nut may be tight on the thread, yet not tight against the bridge;

- Contamination of the thread by dirt, oil or corrosion products, which may prevent the correct tightening of the nut.





- **Pre Use Checks**

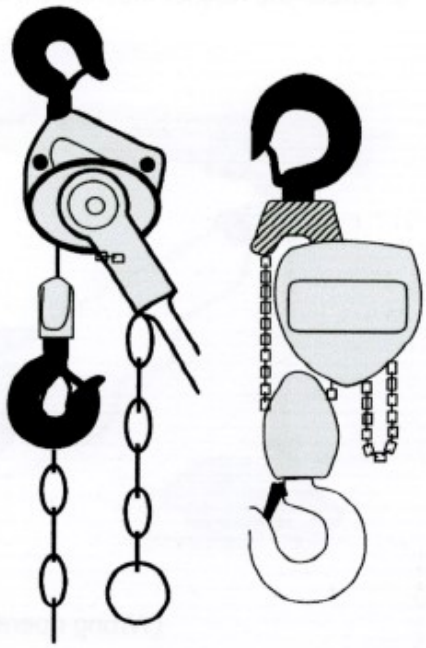
It is required that the products are regularly inspected; this is required because the products in use may be affected by wear, misuse, overloading etc. with a consequence of deformation and alteration of the material structure.

Safe Use of Chain Hoists

Selection

Three main considerations:

- Safe Working Load
- Available Headroom
- Height of Lift



Pullift (horizontal & vertical)

Chain Block (vertical)

Safe Use of Chain Hoists

Pre-use Examination

1. Check top and bottom hooks for signs of stretching.

Ensure safety catches are fitted.

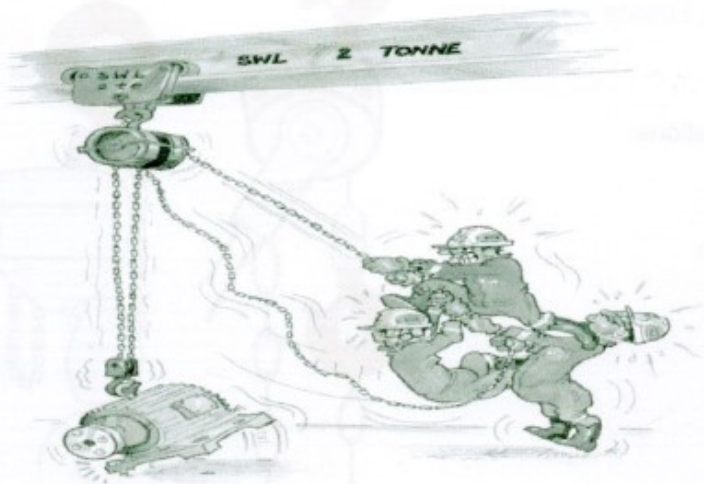
2. Check main body for wear / cracks.

3. Examine load chain and look for stretched, twisted

Or otherwise distorted links.

4. Check hand chain for stretch / check operating lever for distortion (either of the above could be an indication of previous overload).

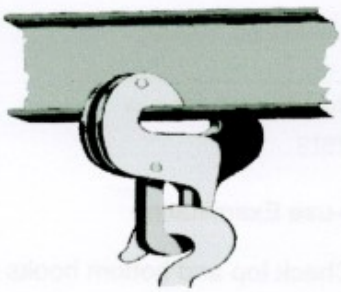
5. Check the ratchet mechanism is healthy.



(Wrong operating, should one man only).

The Safe Use of Beam Clamps

Adjustable Type



Clip-on Type

The Safe Use of Beam Clamps

Pre-use Examination

- Suspension shackle
- Load bar
- Inner and outer clamps
- Jaws
- Adjusting bar
- Female screwed spigots
- Tommy bar
- SWL is Adequate
- Correct Color Code
- I.D. Number Present

Safe Use of Plate Clamps
Selection

- Two basic types available
- Mode of lift - horizontal / vertical
- Required SWL
- Plate thickness
- Locking Mechanism

Horizontal Plate clamp

Universal (Vertical) Clamps

Pre-use Examination

- SWL is Adequate
- Correct Color Code
- I.D. Number Present.

Horizontal Clamps

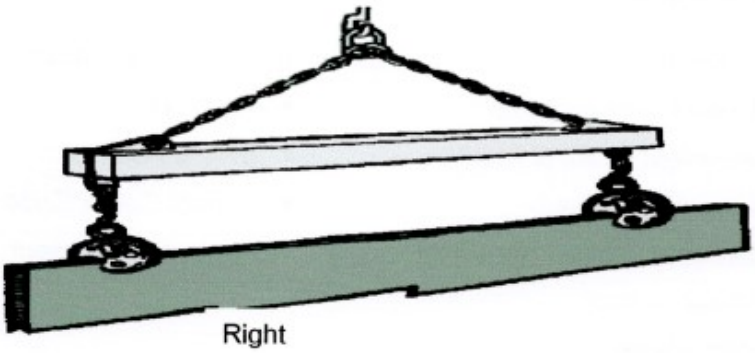
- Hook ring / load bolt / jaws
- Jaws / rocker arm to main body
- Serrations on jaws
- Swivel toe (if fitted)

Universal Clamps

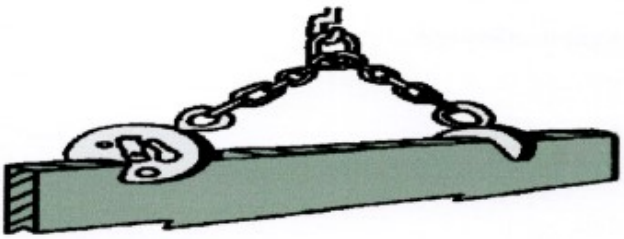
- Hook ring
- Jawpin and nut
- Cam assembly locking

Lever / jaw spring

- Serrations on jaw and pad
- Main body



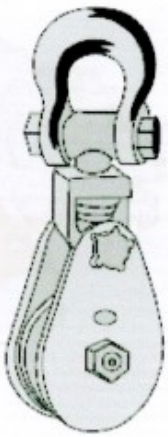
Right



Wrong

Safe Use of Sheave Blocks

Pre-use Examination



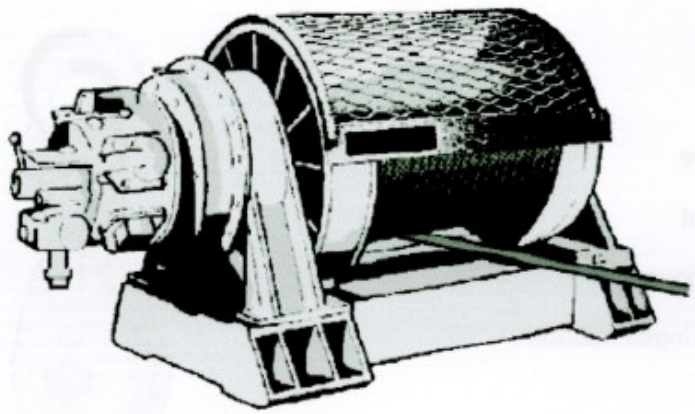
- SWL is Adequate
- Correct Colour Code
- I.D. Number Present
- Sheaves / Rope groove
- Play in sheave bearings / bushes
- Spin the sheaves
- Lubrication points
- Swivel head fittings
- Upper load pin / spigots

The Safe Use of Winches

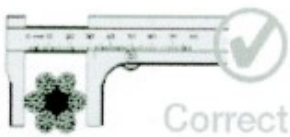
Pre-use Examination: Winch

- Rope guards
- Brake bands and drum
- Automatic brake (if fitted)
- Operation of levers
- Directional arrows are visible
- Check oil level
- Winch base
- Anchorage / support steelwork
- Air supply is adequate
- Function test winch
- Wire rope
- SWL is Adequat
- Correct Colour Code
- I.D. Number Present

Powered (Pneumatic)



and


Correct

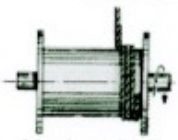

Incorrect

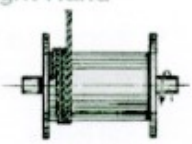
Left Lay - Left Hand


Underwind
(left to right)
Fasten on left


Overwind
(right to left)
Fasten on right

Right Lay - Right Hand


Underwind
(right to left)
Fasten on right


Overwind
(left to right)
Fasten on left

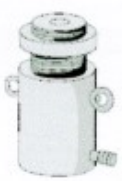



Selection

- Capacity required
- Number & Position of jacks
- Claw attachment
  (60% reduction in capacity)
- Pressure gauges
- Locking collars / safety valves


Ram with integral pump


Ram with remote pump

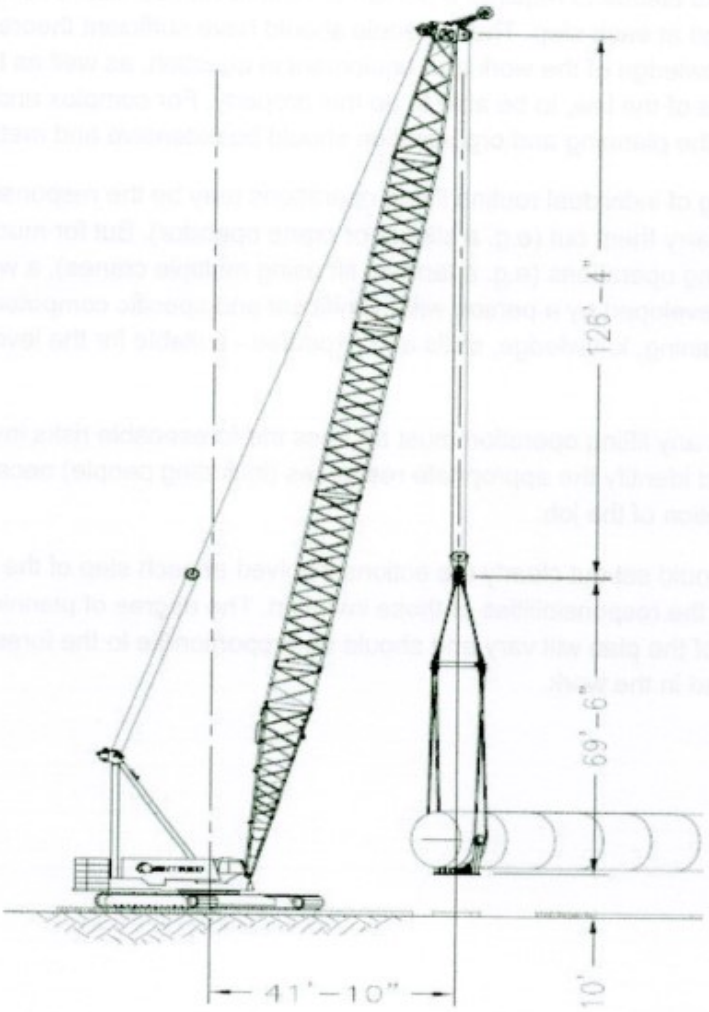



The Safe Use of Hydraulic Jacks / Cylinders

Pre-use Examination

- SWL is Adequate
- Correct Colour Code
- I.D. Number Present
- Body of cylinder / jack
- Function test cylinder / jack
- Inspect ram
- Examine threads / locking collar if fitted
- Oil leaks
- Hoses and fittings
- Oil level
- Function test pump
- Claws (if fitted)
- Gauges

How to complete a lift plan



Complete a Lift Plan

Lifting operations can often put people at great risk of injury, as well as incurring great costs when they go wrong. It is therefore important to properly resource, plan and organise lifting operations so they are carried out in a safe manner. Each of these elements requires a person or people with sufficient competence to be involved at each step. These people should have sufficient theoretical and practical knowledge of the work and equipment in question, as well as the requirements of the law, to be able to do this properly. For complex and high-risk operations, the planning and organisation should be extensive and meticulous.

The planning of individual routine lifting operations may be the responsibility of those who carry them out (e.g. a slinger or crane operator). But for much more complex lifting operations (e.g. a tandem lift using multiple cranes), a written plan should be developed by a person with significant and specific competencies - adequate training, knowledge, skills and expertise - suitable for the level of the task.

The plan for any lifting operation must address the foreseeable risks involved in the work and identify the appropriate resources (including people) necessary for safe completion of the job.

The plan should set out clearly the actions involved at each step of the operation and identify the responsibilities of those involved. The degree of planning and complexity of the plan will vary and should be proportionate to the foreseeable risks involved in the work.

Egyptian Drilling Company
QM-HSE Dept.

LIFTING OPERATION PLAN			
Rig: Plan Ref. #:	Work Permit Ref.#: SJA Ref.#:	Date: Time:	

Brief Description of Lifting Operation (including location)

Possible Considerations - tick if relevant and address each point in "step-by-step" plan section below)

Weight of load unknown	☐	No dedicated Rigging	☐	Lifting thro' substantial heights	☐
High center of gravity	☐	Load has sharp edges	☐	Dynamic factors involved	☐
Unstable load	☐	Extremely heavy load	☐	Hazards to personnel	☐
Awkward size / shape	☐	No lift point above load	☐	Communications	☐
Fragile load	☐	Restricted headroom	☐	Tag lines needed	☐
No dedicated lift points	☐	Confined work area	☐	Poor light conditions	☐

Step by step plan of lifting operation

Route to be travelled & laydown area.

1) Has route to be travelled been selected and cleared of obstructions?	☐ Yes	☐ N/A
2) Is laydown / landing area(s) adequate in both size and load bearing capacity?	☐ Yes	☐ N/A
3) Is suitable packing available for protection of load / slings while landing the load (e.g. timber)?	☐ Yes	☐ N/A
4) Have barriers been positioned to prevent access to unauthorized personnel?	☐ Yes	☐ N/A
5) Have you confirmed that the laydown area is within the operating radius of the crane?	Yes	☐ N/A
6) Will the banksman always be visible to the crane operator or has an alternative method of communication (e.g. radios) been established?	Yes	☐ N/A
7) Have weather conditions been considered regarding their effect on the safety of the lifting operation?	☐ Yes	☐ N/A

Levels of personnel competence & manning levels required:	Banksman Slinger ☐ Qty:		Rigger ☐ Qty:	
	Technician ☐ Qty:		Engineering Support required: Yes ☐ No ☐	
Methods of communication to be used:	Radio ☐	Verbal ☐	Signals ☐	

Rigging / material list:

Ensure all the lifting equipment and accessories have been checked and deemed safe

Lifting operation planned by:	Date:
Job Title:	Signature:
Lifting Operation Approved by:	Date:
Job Title:	Signature:

Lifting Operation Plan
Rev. 02/APR13

شركة الحفر المصرية
قسم الجودة والسلامة والصحة المهنية

خطة عملية الرفع			
جهاز حفر : خطة رقم # :	رقم تصريح العمل # : رقم تحليل العمل الآمن # :	التاريخ : الوقت :	
وصف مختصر لعملية الرفع (يشمل الموقع) :			

الاعتبارات الممكنة (غير مفصلة) – توضع علامة إذا كان ذلك مناسباً و أذكر كل نقطة في القسم التالي (الخطة خطوة بخطوة) :

وزن الحمولة غير معلوم	☐	لا توجد تجهيزات مخصصة للرفع	☐	الرفع من خلال ارتفعات كبيرة	☐
مركز الجاذبية عالي	☐	الحمولة لها حواف حادة	☐	وجود عوامل ديناميكية	☐
الحمولة غير مستقرة	☐	الحمولة ثقيلة للغاية	☐	تعرض العاملين للمخاطر	☐
الحجم / الشكل غير ملائم	☐	لا توجد نقطة للرفع فوق الحمولة	☐	الإتصالات	☐
الحمولة قابلة للكسر	☐	الأرتفاع مفيد	☐	الاحتياج إلى حيل توجيه	☐
لا توجد نقاط مخصصة للرفع	☐	منطقة العمل منحصرة	☐	حالات الاشاعة سيئة	☐

خطة عملية الرفع خطوة بخطوة :

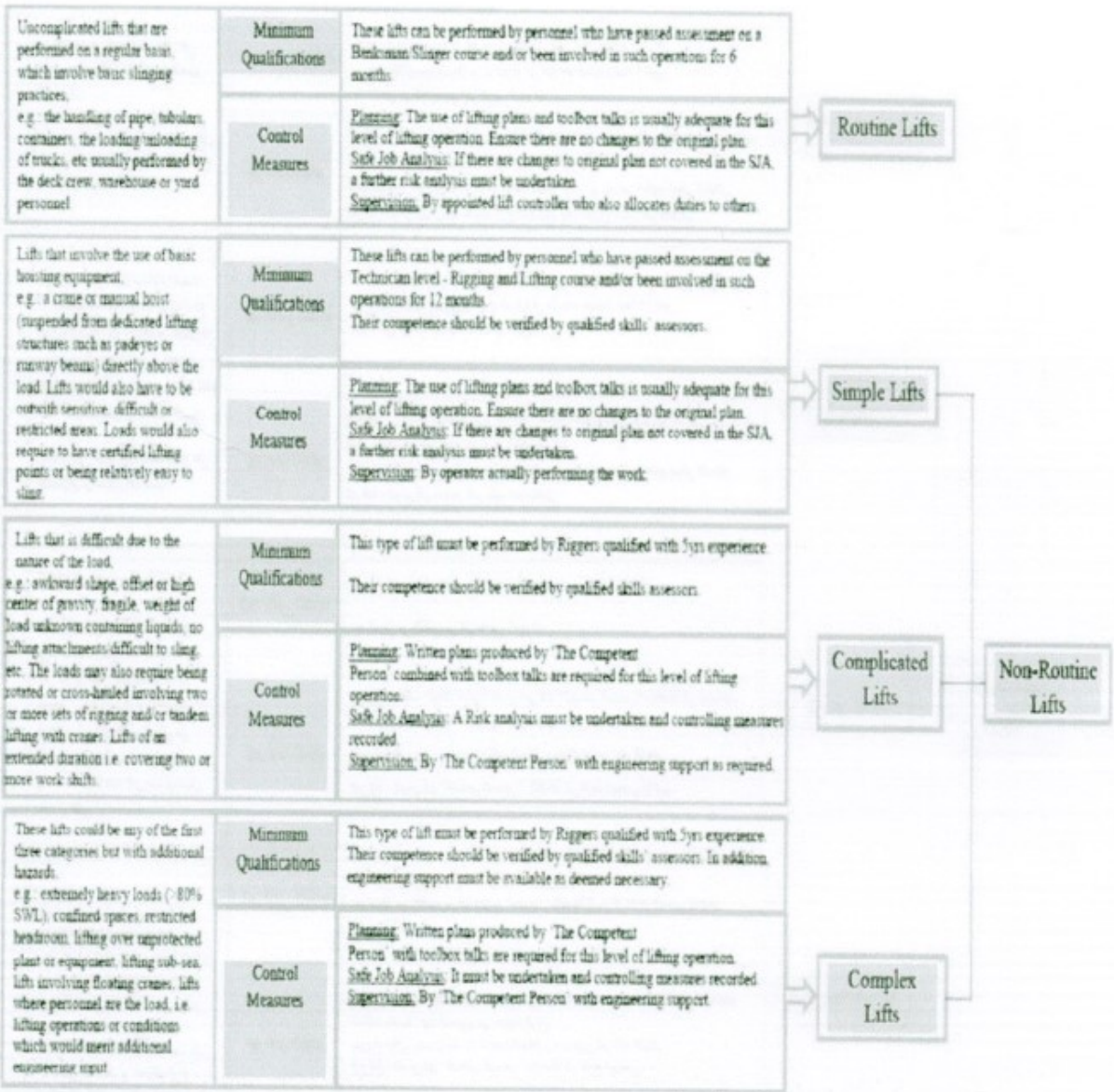
طريق النقل المتبع و منطقة الإرساء :

١) هل طريق النقل المتبع تم تحديده و إخلاءه من العوائق ؟	☐ نعم	☐ غير منطبق
٢) هل مناطق الإرساء / الهبوط مناسبة من حيث المساحة و سعة الحمولة ؟	☐ نعم	☐ غير منطبق
٣) هل هناك طريقة مناسبة للشحن متاحة لحفظ الحمولة / الرافعات عند هبوطها (مثل عارضة خشبية) ؟	☐ نعم	☐ غير منطبق
٤) هل تم وضع الحواجز لمنع دخول أفراد غير مصرح لهم بالدخول ؟	☐ نعم	☐ غير منطبق
٥) هل تم التأكد من أن منطقة الإرساء / الهبوط تقع ضمن مكان تشغيل الرافعة ؟	☐ نعم	☐ غير منطبق
٦) هل مشغل الرافعة يرى الـ بصورة دائمة أو هناك طريقة أخرى للإتصال مثل أجهزة الإرسال اللاسلكية ؟	☐ نعم	☐ غير منطبق
٧) هل تم الأخذ في الأعتبار حالات الجو فيما يتعلق بتأثيرها على سلامة عملية النقل ؟	☐ نعم	☐ غير منطبق

مستويات كفاءة العاملين ومستويات الحماية المطلوبة:	مسئول عملية الرفع ☐ العدد :	مُجهز ☐ العدد :
	قائي ☐ العدد :	الدعم الهندسي مطلوب : نعم ☐ لا ☐
وسائل الاتصال المستخدمه : راديو ☐ شفوي ☐ اشارات ☐		
قائمة التجهيزات / المواد		

التأكد من أن معدات الرفع وجميع الملحقات آمنة وتم فحصها

التخطيط لعملية الرفع بواسطة :	التاريخ :
المسمي الوظيفي :	التوقيع :
التصديق على عمليه الرفع بواسطة :	التاريخ:
المسمي الوظيفي :	التوقيع :


Uncomplicated lifts that are performed on a regular basis which involve basic slinging practices,
e.g.: the handling of pipe, tubulars, containers, the loading/unloading of trucks, etc usually performed by the deck crew, warehouse or yard personnel
Minimum Qualifications
These lifts can be performed by personnel who have passed assessment on a Banksman Slinger course and/or been involved in such operations for 6 months
Control Measures
Planning: The use of lifting plans and toolbox talks is usually adequate for this level of lifting operation. Ensure there are no changes to the original plan.
Safe Job Analysis: If there are changes to original plan not covered in the SJA, a further risk analysis must be undertaken.
Supervision: By appointed lift controller who also allocates duties to others
Routine Lifts
Lifts that involve the use of basic hoisting equipment,
e.g.: a crane or manual hoist (suspended from dedicated lifting structures such as padeyes or runway beams) directly above the load. Lifts would also have to be outwith sensitive, difficult or restricted areas. Loads would also require to have certified lifting points or being relatively easy to sling.
Minimum Qualifications
These lifts can be performed by personnel who have passed assessment on the Technician level - Rigging and Lifting course and/or been involved in such operations for 12 months
Their competence should be verified by qualified skills' assessors.
Control Measures
Planning: The use of lifting plans and toolbox talks is usually adequate for this level of lifting operation. Ensure there are no changes to the original plan.
Safe Job Analysis: If there are changes to original plan not covered in the SJA, a further risk analysis must be undertaken.
Supervision: By operator actually performing the work
Simple Lifts
Lifts that is difficult due to the nature of the load,
e.g.: awkward shape, offset or high centre of gravity, fragile, weight of load unknown containing liquids, no lifting attachments difficult to sling, etc. The loads may also require being rotated or cross-hauled involving two or more sets of rigging and/or tandem lifting with cranes. Lifts of an extended duration i.e. covering two or more work shifts.
Minimum Qualifications
This type of lift must be performed by Riggers qualified with 5yrs experience
Their competence should be verified by qualified skills assessors
Control Measures
Planning: Written plans produced by 'The Competent Person' combined with toolbox talks are required for this level of lifting operation.
Safe Job Analysis: A Risk analysis must be undertaken and controlling measures recorded.
Supervision: By 'The Competent Person' with engineering support as required.
Complicated Lifts
These lifts could be any of the first three categories but with additional hazards
e.g.: extremely heavy loads (>80% SWL); confined spaces, restricted headroom, lifting over unprotected plant or equipment, lifting sub-sea, lifts involving floating cranes, lifts where personnel are the load, i.e. lifting operations or conditions which would merit additional engineering input
Minimum Qualifications
This type of lift must be performed by Riggers qualified with 5yrs experience
Their competence should be verified by qualified skills' assessors. In addition, engineering support must be available as deemed necessary
Control Measures
Planning: Written plans produced by 'The Competent Person' with toolbox talks are required for this level of lifting operation.
Safe Job Analysis: It must be undertaken and controlling measures recorded
Supervision: By 'The Competent Person' with engineering support
Complex Lifts
Non-Routine Lifts

الرفعات الروتينية

هي الرفعات غير المعقدة التي تنفذ على أساس منتظم و التي تشمل مهام التجهيز الأساسية . مثل التعامل مع المواسير ، الأنابيب ، الحاويات ، شحن و تفريغ الشاحنات .. إلخ و التي تتم بصورة معتادة من قبل طاقم السطح و العاملين بالمخازن أو الفناء	الحد الأدنى للكفاءة	عمليات الرفع هذه يمكن أن تنفذ من قبل العاملين الذين إجتازوا أختبار دورة ال Banksman/Slinger و/ أو شاركوا في مثل هذه العمليات لمدة ٦ أشهر. يتم التحقق من كفائتهم من قبل مقيمي المهارات.
	إجراءات التحكم	التخطيط : إن استخدام خطط الرفع و اجتماعات السلامه عادة ما يكون ملائم لهذا المستوى من عمليات الرفع. يجب التحقق من عدم وجود تغيرات في الخطة الأصلية. تقييم المخاطر: عند وجود تغييرات في الخطة الأصلية يجب أن يتم إجراء تقييم إضافي للمخاطر. المراقبة: تتم من قبل مراقب عمليات الرفع الذي يقوم أيضاً بتوزيع المهام على الآخرين.

الرفعات الغير روتينية

الرفعات البسيطة

هي الرفعات التي تشمل استخدام المعدات الأساسية للرفع ، مثل الرافعة أو قلة الرفع اليدوية (يجب أن تكون معلقة من هيكل رفع مخصصة مثل أعين التحميل أو العوارض المعرجة) مباشرة فوق العمل. أيضاً الرفعات المتسانه ,الصعبه او في المناطق الضيقه. يجب أن يكون هناك نقاط محددة للرفع على الأحمال أو أن يسهل رفعها نسبياً	الحد الأدنى للكفاءة	عمليات الرفع هذه يمكن أن تنفذ من قبل العاملين الذين إجتازوا الأختبار على المستوى الفني – دورة ال Rigging and Lifting و/ أو شاركوا في مثل هذه العمليات لمدة ١٢ شهر. يتم التحقق من كفائتهم من قبل مقيمي المهارات
	إجراءات التحكم	التخطيط : إن استخدام خطط الرفع و اجتماعات السلامه عادة ما يكون ملائم لهذا المستوى من عمليات الرفع. التحقق من عدم وجود تغيرات في الخطة الأصلية. تقييم المخاطر: عند وجود تغييرات في الخطة الأصلية يجب أن يتم إجراء تقييم إضافي للمخاطر. المراقبة : تتم من قبل المشغل الذي يقوم غالباً بالعمل

الرفعات المعقدة

الرفعات الصعبة بسبب طبيعة الحمولة مثل: الأحمال ذات الأشكال الغريبة, ذات مركز جاذبية مرتفع قابلة للكسر, تحتوي على سوائل بدون نقاط تحميل) صعبة التجهيز ... إلخ الأحمال قد تتطلب الدوران أو إمالة باستخدام طاقمين او اكثر من التجهيزات و/او تحميل تراكبي برافعات. رفعات ذات وقت ممتد التي تمتد لوردبتان عمل او اكثر.	الحد الأدنى للكفاءة	هذا النوع من الرفع يجب أن ينفذ من قبل المجهزين ذوي خبرة ٣ سنوات . يتم التحقق من كفائتهم من قبل مقيمي المهارات .
	إجراءات التحكم	التخطيط : يتطلب الخطط المكتوبة الصادرة من قبل "الشخص المختص" بالإضافة إلى اجتماعات السلامه المناسبة لهذا المستوى من عمليات الرفع. تقييم المخاطر: يجب أن يتم إجراء تقييم المخاطر و يتم تكوين إجراءات التحكم المراقبة : تتم من قبل "الشخص المختص" بالإضافة إلى الدعم الهندسي اذا لزم

الرفعات المركبة

هذه الرفعات من الممكن ان تكون أيا من الانواع الثلاث لكن بأخطار اضافية. مثال: الأحمال الثقيلة التي تتخطى > 80% SWL, المناطق المغلقه, الإرتفاع الشاهق, التحميل فوق منشئة حيوية او منشآت غير مؤمنة, الرفعات بمشاركة غواصين, الرفعات بمشاركة رافعات عائمة, رفعات حيث يكون الأشخاص هم الحمل او عمليات الرفع الحالات التي تتطلب متطلبات هندسية إضافية.	الحد الأدنى للكفاءة	هذا النوع من الرفع يجب أن ينفذ من قبل المجهزين ذوي خبرة ٥ سنوات . يتم التحقق من كفائتهم من قبل مقيمي المهارات, بالإضافة إلى توافر الدعم الهندسي إذا دعت الضرورة لذلك .
	إجراءات التحكم	التخطيط : يتطلب الخطط المكتوبة الصادرة من قبل "الشخص المختص" بالإضافة إلى اجتماعات السلامه المناسبة لهذا المستوى من عمليات الرفع. تقييم المخاطر: يجب أن يتم إجراء تقييم المخاطر و يتم تكوين إجراءات التحكم المراقبة : تتم من قبل "الشخص المختص" بالإضافة إلى الدعم الهندسي

Correct Crane Signals

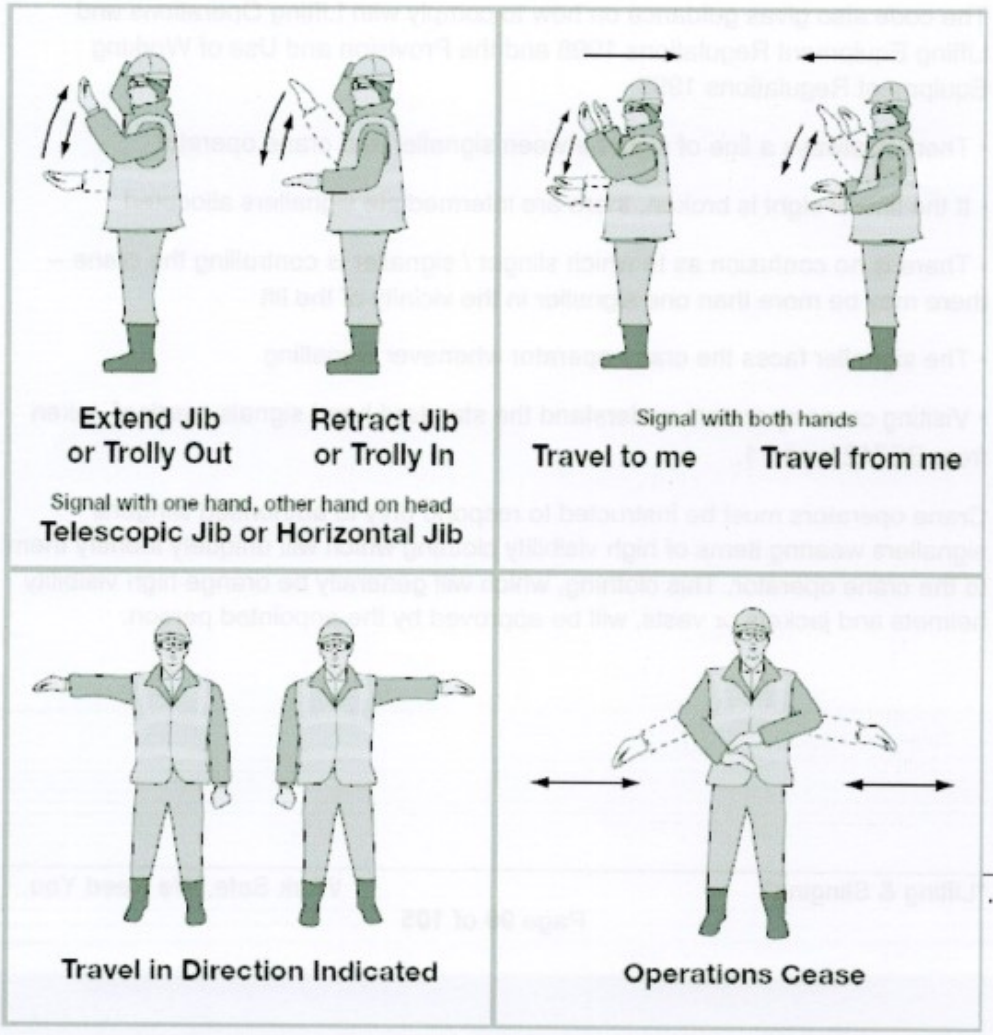
BS7121 is the British Standard Code of Practice for the Safe Use of Cranes. It is recognized as best practice in the industry and has been drawn up by the industry in conjunction with the Health and Safety Executive (HSE). HSE recommends the use of BS7121 to any person or organisation who have duties under the Health and Safety at Work Act 1974 and who use or hire cranes.

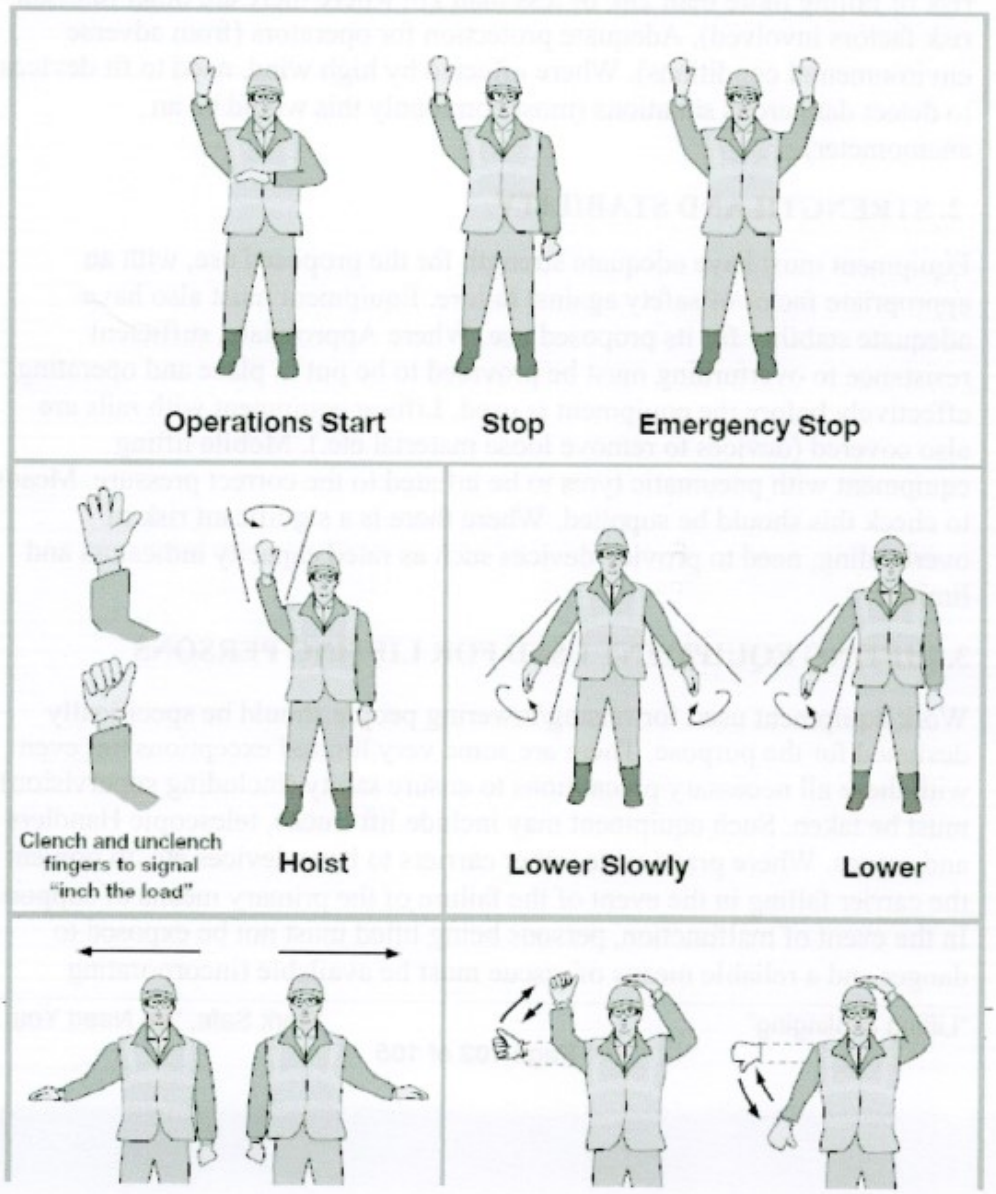
The code also gives guidance on how to comply with Lifting Operations and Lifting Equipment Regulations 1998 and the Provision and Use of Working Equipment Regulations 1998.

- There is always a line of sight between signaller and crane operator
- If the line of sight is broken, there are intermediate signallers allocated
- There is no confusion as to which slinger / signaller is controlling the crane – there may be more than one signaller in the vicinity of the lift
- The signaller faces the crane operator whenever signalling
- Visiting crane operators understand the standard hand signals overleaf, taken from BS7121: part 1.

Crane operators must be instructed to respond only to authorised slingers/ signallers wearing items of high visibility clothing which will uniquely identify them to the crane operator. This clothing, which will generally be orange high visibility helmets and jackets or vests, will be approved by the appointed person.

Crane signals in accordance with BS 7121




Operations Start
Stop
Emergency Stop
Clench and unclench fingers to signal "inch the load"
Hoist
Lower Slowly
Lower

Correct Selection of Lifting Equipment

1. SUITABILITY OF LIFTING EQUIPMENT

When selecting lifting equipment, the ergonomic risks need to be considered. Material of manufacture needs to be suitable for conditions of use. Means of access/egress need to be safe and suitable. Need to minimise risks from slips, trips and falls from any part of the lifting equipment (e.g. cover or fence any floor openings, suitable edge protection where there is a risk of falling more than 2m, or less than 2m where there are other relevant risk factors involved). Adequate protection for operators (from adverse environmental conditions). Where affected by high wind, need to fit devices to detect dangerous situations (most commonly this would be an anemometer).

2. STRENGTH AND STABILITY

Equipment must have adequate strength for the proposed use, with an appropriate factor of safety against failure. Equipment must also have adequate stability for its proposed use. Where Appropriate, sufficient resistance to overturning must be provided to be put in place and operating effectively before the equipment is used. Lifting equipment with rails are also covered (devices to remove loose material etc.). Mobile lifting equipment with pneumatic tyres to be inflated to the correct pressure. Means to check this should be supplied. Where there is a significant risk of overloading, need to provide devices such as rated capacity indicators and limiters.

3. LIFTING EQUIPMENT USED FOR LIFTING PERSONS

Work equipment used for raising/lowering people should be specifically designed for the purpose. There are some very limited exceptions but even with these all necessary precautions to ensure safety (including supervision) must be taken. Such equipment may include lift trucks, telescopic Handlers and cranes. Where practicable, other carriers to have devices etc. to prevent the carrier falling in the event of the failure of the primary means of support. In the event of malfunction, persons being lifted must not be exposed to danger and a reliable means of rescue must be available (incorporating

means to summon assistance, emergency means of lowering the carrier or self-rescue equipment).

Complete a Safe Lifting Operation

- Essential Safety Principles for a safe Lifting Operation:

- Lifting Plan

All lifting operations should have a lifting plan supported by a risk assessment

- Risk Assessment

Prior to any lifting operation, a risk assessment should be conducted to identify the hazards that are likely to occur. By assessing the likelihood and severity of the accidents that may occur, appropriate risk control measures can be undertaken to eliminate the hazards or reduce risks.

- Permit-to-Work (PTW)

To have safe lifting carried out in the worksite, all occupiers of worksites must implement a PTW system for any non-routine lifting operation.

- Pre-use Inspection

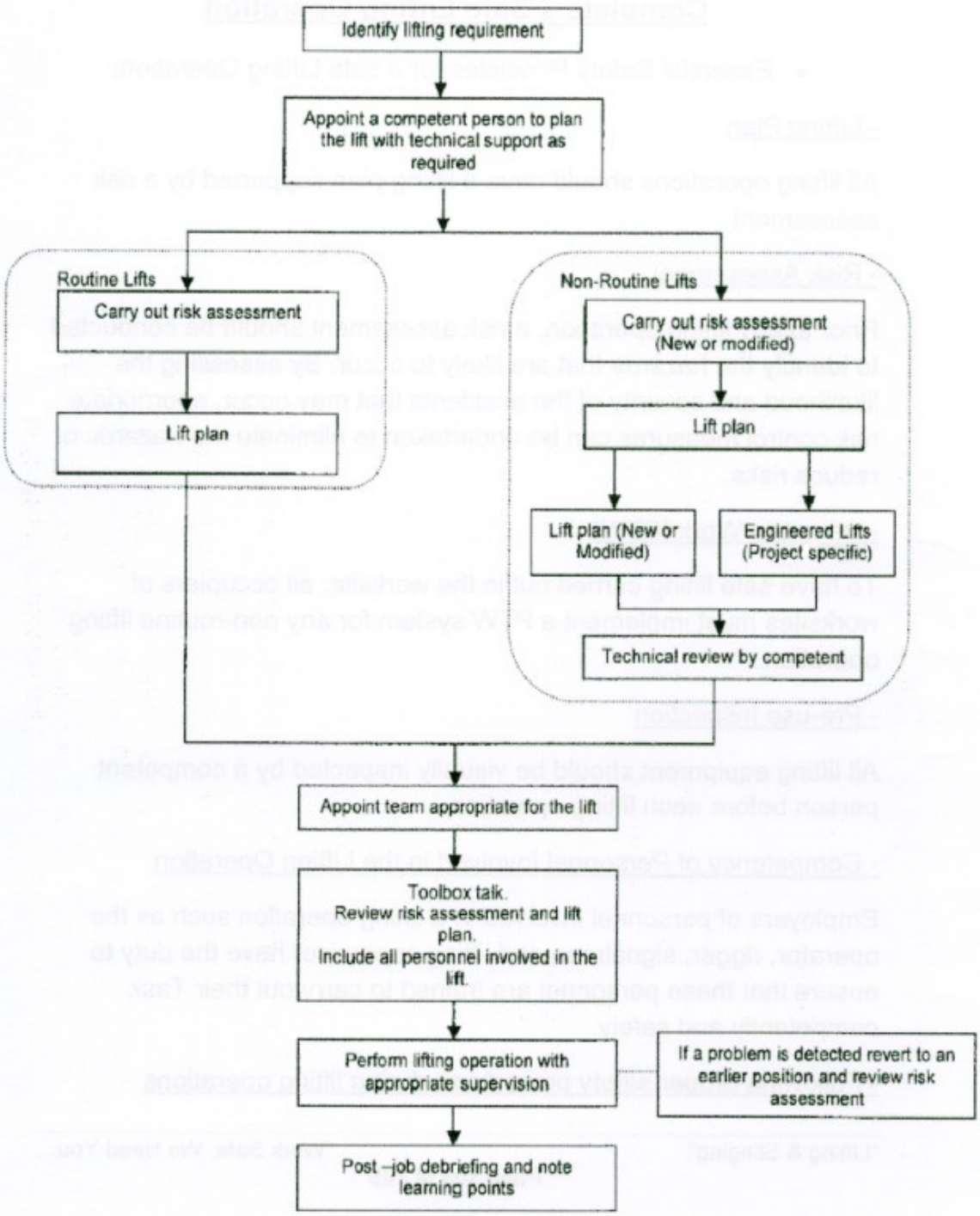
All lifting equipment should be visually inspected by a competent person before each lifting operation.

- Competency of Personnel Involved in the Lifting Operation

Employers of personnel involved in a lifting operation such as the operator, rigger, signalman and lifting supervisor have the duty to ensure that these personnel are trained to carry out their Task competently and safely.

- Following proper safety procedures during lifting operations

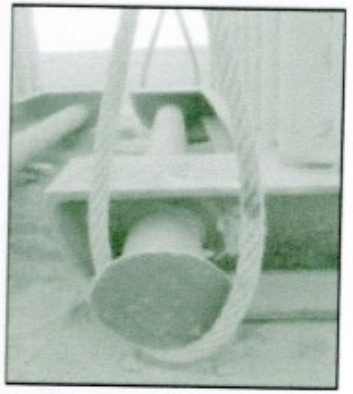
Following safe operating procedures of lifting devices is an absolute must.



EDC Rig 16 HPNM Flipped Over Mud Pump – 02 December 2014

Incident Description

In order to clean the mud pump, AFM hooked up the double leg lifting wire slings to the two Cranes and then he asked the crane operators to start the lifting operation but one of the crane operators asked him to issue a PTW before starting the job. While the AFM was issuing the PTW and Lifting Plan for the task, the two crane operators decided to start lifting the Mud Pump and while the cranes booms were moving to the left side in order to put the mud pump on the racks, one of the two wire rope slings slipped from the lug leading to flip the Mud pump and dropped over the racks.



Causes

- Lack of Leadership from Rig Management; as they planned for the job without ensuring that all the involved personnel were aware of the job hazards.
- Lack of Task Planning; as no proper risk assessment was performed for the task; SJA, PTW, Lifting Plan and PJSM were not issued nor discussed prior to starting the job.
- Improper Slinging; as the double lifting wire sling (3 ft. soft eye) was not attached properly to the mud pump lug (see attached photos).
- Crane operators started the job without supervision or instruction from the rig management to do the job alone.

Actions

- STP shall ensure that no job will be conducted on the rig without proper risk assessment and proper planning and these shall be reviewed during Superintendent Visits.
- Pre-Job Safety Meeting shall be conducted prior to starting any job discussing the job steps, hazard, controls and specify the entire involved personnel role.
- All lifting operations must be properly planned and supervised by a competent person with the required knowledge and training *(EDC Safety manual, item 5. Lifting operations and lifting equipment CH # 5.8 page 257).*
- New crane operators shall work under proper supervision and support until they become competent enough and assess their competency by their supervisors, competency program shall be reviewed.

Page 1 of 1

Case Study

Egyptian Drilling Company
EDC Training Center